MALLI

BUSINESS RESEARCH METHODS

MBA, SECOND SEMESTER

According to the New Syllabus of **'Anna University, Chennai'**

Dr. T. Vetrivel

Ph.D., M.Phil, MBA

Professor & Head, Department of Management Studies,

Velalar College of Engineering & Technology, Erode

Dr. P. Priyadarsini

Ph.D., M.Phil, MBA, M.Sc. (Psychology),

Associate Professor & Head, Department of Management Studies,

Tagore Engineering College, Chennai

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Business Research Methods

- *Dr. T. Vetrivel*
- *Dr. P. Priyadarsini*

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"Dedicated

to

*the beloved **Students** of MBA & MIB Courses"*

- Dr. T. Vetrivel

"Dedicated

to

*the **Almighty**"*

- Dr. P. Priyadarsini

Preface

The world of research is fast-paced, dynamic and always in a state of change. Understanding the complexities and rapid development of research requires an insider's perspective. Research is the first and foremost tool to aid in making business decisions. While we recognise the need for rigorous scientific applications of research, we argue that the bottom-line measure of success is the practical ability of information to increase the quality of business decisions.

The book **'Business Research Methods'** has been written for the management students to learn about the concept with practical aspects on research methodology. Also, this book will enable the research ideas to the research scholars and industrialists those who are interested in researching and testing their views by applying latest technologies.

This book covers different aspects of research. The book is based on an emerging market perspective, particularly drawn from the Indian context. This book will help in bridging the information gap and will be need-based informative literature for the students of management. The book consists of the various issues, challenges and opportunities that lie within the periphery of research.

We sincerely believe that students should acquire balanced knowledge of theory as well as practical aspects of the subject. We have structured the fundamentals in concise and accurate form.

We are expecting valuable suggestions for improvement from our dear students and lecturers, which will be useful for our next edition.

Please e-mail us at, **thakurpublication@gmail.com**
or contact at, **www.tppl.org.in**

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Above all, I am grateful to the **Almighty**, for His blessings and grace.

- Dr. T. Vetrivel

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I wish to express my deep sense of gratitude to my **Family**, **Close Friends** and **Relatives**, for their encouragement and valuable assistance.

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- Dr. P. Priyadarsini

(BA5202)

BUSINESS RESEARCH METHODS

Unit-I: Introduction (9)

Business Research – Definition and Significance – the research process – Types of Research – Exploratory and causal Research – Theoretical and empirical Research – Cross –Sectional and time – series Research – Research questions / Problems – Research objectives – Research hypotheses – characteristics – Research in an evolutionary perspective – the role of theory in research.

Unit-II: Research Design and Measurement (9)

Research design – Definition – types of research design – exploratory and causal research design – Descriptive and experimental design – different types of experimental design – Validity of findings – internal and external validity – Variables in Research – Measurement and scaling – Different scales – Construction of instrument – Validity and Reliability of instrument.

Unit-III: Data Collection (9)

Types of data – Primary *vs.* Secondary data – Methods of primary data collection – Survey *vs.* Observation – Experiments – Construction of questionaire and instrument – Validation of questionaire – Sampling plan – Sample size – determinants optimal sample size – sampling techniques – Probability *vs.* Non–probability sampling methods.

Unit-IV: Data Preparation and Analysis (9)

Data Preparation – editing – Coding –Data entry – Validity of data – Qualitative *vs.* Quantitative data analyses – Bivariate and Multivariate statistical techniques – Factor analysis – Discriminant analysis – cluster analysis – multiple regression and correlation – multidimensional scaling – Conjoint Analysis - Application of statistical software for data analysis.

Unit-V: Report Design, Writing and Ethics in Business Research (9)

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UNIT 1

Introduction to Business Research

1.1. RESEARCH

1.1.1. Introduction

Research comprises of two words, "Re" and "search". While "Re" implies a repetitive or iterative process, "Search" denotes making a thorough examination of or looking over carefully in order to find something. Different researchers have defined research in various ways due to its wide scope. But, in general, research can be defined as a scientific process where new facts, ideas, and theories are established and/or proved in different areas of knowledge. Research aims at adding to the existing stock of knowledge for the betterment of world.

According to John Best, "Research is a systematic activity directed towards discovery and the development of an organised body of knowledge".

According to Waltz and Bausell, "Research is a systematic, formal, rigorous and precise process employed to gain solutions to problems or to discover and interpret new facts and relationships".

According to Clifford Woody, "Research comprises defining and redefining problems, formulating hypothesis or suggested solutions, Collecting, Organising and Evaluating data, Making deductions and reaching Conclusions to determine they fit the formulating hypothesis".

Research involves scientific and systematic analysis of a research area and concluding the findings with appropriate reasoning. It is a systematic as well as an object-oriented process. The process of research begins with identifying the research problem; following data collection, data analysis, and ends with conclude the findings. It should be conducted in an unbiased manner, without manipulating the findings.

Research plays a vital role in management decision-making by analysing the situation systematically and finding new ways to support the operations. **For example,** a company may conduct research to know the consumer reviews about certain products.

Research can be carried-out using various methods and techniques which are collectively called as '**research methods**'. Research methods are the tools and techniques for analysing and collecting data so that meaningful outcomes can be extracted from the problem being studied. '**Research methodology**' can be defined as the scientific procedure to solve various problems related to research. It has a wider scope than research methods, as in addition to the methods and techniques, the researcher designs different methodologies for different research problems. Research methodology varies according to the research problem. Therefore, it is concerned with the application of research methods as per the requirement.

1.1.2. Nature of Research

Nature of research is as follows:

1) **Systematic Activity:** Research follows a systematic procedure to analyse a research problem in a better way. A research cannot be conducted in a haphazard manner. A researcher can come to a step only when the previous one is completed.
2) **Logical Process:** The basic tenet of research is "logic". All the assumptions and analyses undertaken are based on certain logic. Research is a scientific, systematic, and planned investigation to understand the underlying problem.

3) **Iterative Process:** Research is an iterative process. Sometimes it becomes necessary for the researcher to review the work of earlier stages, which makes it cyclic in nature. Often it becomes harder for the researcher to find out the starting and ending points.

4) **Based on Empirical Evidences:** Research studies are empirical in nature. Every step in research is carried-out using various scientific tools and techniques. Every step in research is checked for accuracy and is based on observable experiences or empirical evidences. Therefore, quantitative research is easier to validate than qualitative research, which is more conceptual in nature.

5) **Controlled in Nature:** The researchers often control the effect of variables by allowing only some variables to vary so that their effects can be tested. Due to this reason, controlling the variables in a scientific research is much easier than controlling the factors in a social research. Hence in research, it is very essential to control the variables carefully.

1.1.3. Objectives of Research

Research strives to achieve following five objectives:

1) **To Explore about Unknown:** One of the prime objectives of research is to explore the unknown object or phenomenon. While exploring, a researcher tries to understand the details of the situation or phenomenon for developing preliminary hypotheses and generalisations. Exploring allows the researchers to develop theories and explains the questions of how and why a phenomenon operates in a particular way.

2) **To Describe the Features:** Research seeks to describe the features of a phenomenon. It is one of the core activities of research where a researcher either observes the phenomenon and records its characteristic behaviour, or conducts standardised tests to measure the behaviour, or describes the change in attitude or opinion of the object. **For example**, a researcher can describe the behaviour of smokers by either observing it, or analysing their behaviour by undergoing some standard tests, such as measuring the level of resistance, per day consumption, etc.

3) **To Explain a Phenomenon:** Another objective of research is to provide explanation. Here, the researcher aims to explain how and why a phenomenon operates in a specific way. The researchers develop certain theories explaining the behaviour of a particular phenomenon by determining the factors that cause the change and identifying their effects on the phenomenon. Most of the scientific and educational researches have this objective for their studies. **For example**, if a researcher is trying to know, "Do weekend parties for employee families improve work life balance?", then in this case, the cause is 'weekend parties' and the effect is 'work life balance'.

4) **To Predict Future Activities:** Research is also conducted with the aim of predicting the future activities. Prediction can be done on the basis of explanations regarding a phenomenon. Hence, having adequate prior information is essential for making forecasts. Forecasting activity can also be performed on the research based on explanation. Here, predictions are made on the basis of cause and effect relationships in a phenomenon. A good example of this objective is the research that analysts conduct during elections to predict the winning political party based on the information that they are able to gather from the voting polls.

5) **To Influence Activities:** The last objective of a research study is known as controlling or influencing particular phenomenon. Here, the research emphasises on applying the existing theories and models instead of developing new theories, for influencing various facets of environment. Most of the research conducted in social, behavioural and educational research falls under the area of influence.

1.1.4. Research Process

Discovering and analysing a range of significant and reliable information about a particular issue or problem with systematic planning is known as research process. This process involves several steps for complete analysis of the research problem. These steps are required for identifying and analysing important information about a research topic. The steps of research process are described below.

) **Selecting the Research Topic:** In order to carry out the research in an orderly and coherent way, a sequence of actions or steps is needed to be followed. The foremost work in this direction is selecting a topic for the research. While selecting the topic for research, the foremost task is to narrow down the potential ones among the available issues in that particular area of research.

While selecting research topic, the researcher should keep in mind that the research problem should be neither too broad nor too narrow. The research topic should be selected in a way that can be clearly defined and understood. Since, it is not a methodical step hence, selecting a research topic requires knowledge and significant time.

An efficient research study begins with a research topic. Research topic should be defined in such a way that the further stages can be carried-out effectively. As soon as the research topic and related questions are formulated, researchers proceed further to select research design and collect data. Hence, this step should be performed carefully, as it one of the most important foundations for making decisions.

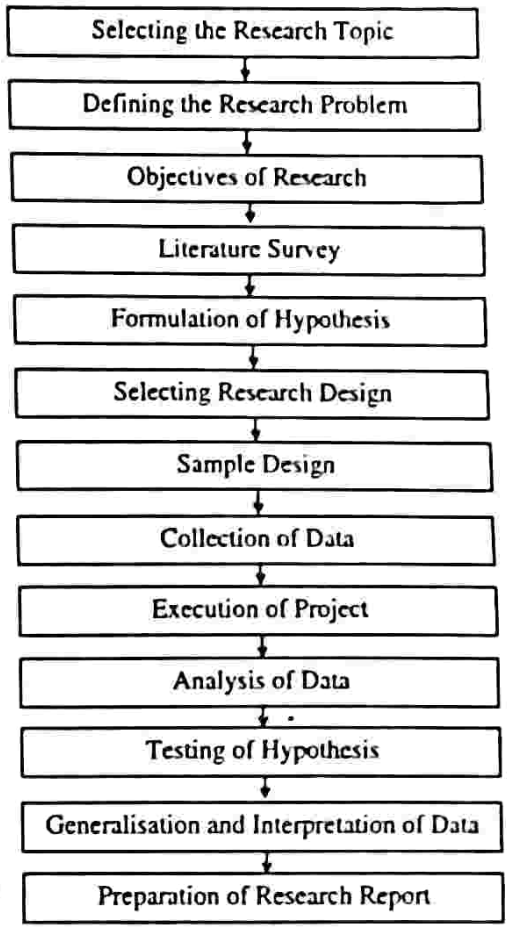


Figure 1.1: Research Process

2) **Defining Research Problem:** The next step of research process after selecting research topic is defining research problem. The research problem should be defined clearly and precisely. The research problem which is clearly defined solves half of the problem. Defining the research problem precisely for some researches is not possible. **For example,** defining research problem for poor sales is a difficult task, as it needs exploratory research to explore the area further.

A well-defined research problem is crucial for fulfilling the requirements of a research study. In this step, all the aspects of related to the research problem are identified after which a problem statement is formulated. Many crucial decisions are based on the problem statement. If the problem statement is defined precisely, then it helps the researchers to select the research design and data collection methods easily. Research problem should be defined in such a way so that all the time, money and effort put forward for the research does not go wasted. This is the most critical step in all the research process as improper definition of the research problem can cause the failure of entire research study.

3) **Objectives of Research:** After defining the research problem, the next stage is to set the research objectives. Research objectives defined in clear terms help the researchers to proceed in certain direction. It prevents the researchers from further distractions and enables them an issue to focus on. Research objectives construct the foundation for the research work. It is an essential ingredient of a research, as the entire effort and resources are applied to accomplish the research objectives. It helps the researchers to provide answers for the specific research questions. Thus, determining research objectives is the critical part of the research process as it supports the completion of the whole research. While defining research objectives the researchers should always remember that these should be comprehensive as well as attainable.

The objectives of the research are helpful in clarifying the type and level of information required for completing the research. This information requirement is further described by the nature of the research as well as by design used in the research. These objectives are the focal point of the any research as answering questions related to these objectives, would result in the completion of the procedure.

4) **Literature Survey:** The next step in the process of research is to analyse the available literature related to the research area. Available literatures allow the researcher to analyse the previously researches that have been published by different researchers in that field. The prime purpose of literature survey is to provide the researchers an idea about the area of knowledge and highlights the issues that needs be researched. Hence, surveying the literature is one of the most important steps in the research process.

Often literature survey provides data accumulated during a certain time-period. It generally has a specific organisational pattern, but it can also contain just the summaries of sources. While summary includes reviewing important information from different sources, the synthesis or combination of information is the

reshuffling or rearranging of information. This helps the researchers in developing new interpretations from the old information. This literature review may also be useful in developing intellectual knowledge of the research area alongwith significant arguments or discussions. Literature survey guides the researchers to evaluate the sources, and recommends them to collect data from relevant literatures only.

5) **Formulation of Hypothesis:** When literature is thoroughly surveyed, the researchers move to the next step, i.e., formulation of hypothesis. To formulate research hypothesis, the prime task is to identify the potential variables of the study, after which relationship statement is formulated on the basis of an expected relation between the variables. This statement is more focused compared to the research objectives. **For example,** in case of research problem related to effect of violent content of TV on behaviour of children, the hypothesis may be formed as "Violent content of the TV is responsible for the aggressive behaviour of the children". Here violent content of the TV is independent variable and behaviour of children is dependent variable, and a positive relationship is predicted by the researcher.

The dependent and independent variables alongwith target population are also described with the help of hypothesis to make the research subject clearer. The collected data is analysed and tested to prove the hypothesis and establish a relation between variables.

6) **Selecting Research Design:** Next step in the research process is developing the research design. Research design allows the researchers to answer to the research questions in an accurate, economical, and objective manner. Any research design performs two major functions:
   i) Preparing a structured plan outlining various methods and techniques required in conducting the research.
   ii) Making sure that these methods and techniques are suitable for the research. It also ensures that these techniques will help in finding objective, precise, and suitable answers to the research questions. According to **Kerlinger,** this function is called "control of variance".

With the help of research design, a researcher is able to decide the necessary tasks to perform at each step of the research. This plan helps in effective utilisation of time and resources. Therefore, research design can also be referred as the blueprint of the research. Research design is prepared to regulate and control every step of the research, which is the most vital issue of any study. Hence, it is considered as one of the most crucial stages in the entire research process.

7) **Sample Design:** As soon as the design of research is selected, the next task is to select the sample design. Sample design sets a platform for effective data collection and analysis. A sample design is responsible for the effective selection of research samples. Selecting sample design affects many aspects related to the research work. Hence, selection of suitable sample design should be carefully performed.

Designing of sample includes many important decisions such as deciding the sample frames, selecting suitable sampling technique, determining sample size, etc. Sampling design should be performed in such a way that the quality of research is maintained in an economic way. Sample design permits the study of a representative part of the target population, which results in reduction of unnecessary utilisation of money, time, and effort. This representative part or sample provides useful information which represents the larger target population.

8) **Collection of Data:** After finalising the sample in the previous step, the required data is collected from the sample of population. Actually this step is an intermediary stage between theoretical and practical aspects of a research. In the beginning of the research process, a basic idea about a research problem is developed with the help of available knowledge. After the research problem is formulated, data collection is performed systematically. Without having accurate data about the research problem, it is not possible to complete a study as it works as a source of information helpful in getting the solution. The methods used for data collection depend on the type and nature of the research. The few common methods are surveys, interviews, observation, case studies, etc.

Before collecting the data it is necessary for the researcher to select the research area, define the research problem/question, and select samples. Data collection is done prior to the phase of data analysis and reporting. The data collected is analysed and used for either supporting or replacing the philosophies presented by earlier related researches. Data collection plays a crucial role in combining the theories with their practical applications.

9) **Execution of Project:** It is the next step in the research process after the collection of data. In this step, the real execution of the research takes place. It is also known as the implementation stage of the research process. This step is responsible for the systematic execution of the research in reasonable time. The correctness and reliability of the collected data depends upon the efficient and feasible execution of the research process. To ensure smooth execution of research project, structured questionnaire can be used, where the questions and answers should be machine-coded. Various types of interviews can also be selected for data collection, but the interviewers should be trained and skilled enough. In this step, the researcher ensures that the research is executed as per the pre-set standards. Research process should be executed in an ethical manner. There should be no restriction on publishing of collected data. Other important aspects of the execution step are interpreting data accurately, and designing suitable formats for presenting the findings to particular audiences.

10) **Analysis of Data:** After collecting data and successfully executing the fieldwork, the collected data are analysed. Data analysis is very essential to draw-out the required information from the raw data by making it organised and meaningful. Organising and analysing the data facilitates the researchers to understand the feature of sample. There are many techniques available to analyse the data. Sometimes during data analysis, researchers manipulate the data to get desired conclusions or outcomes. Therefore, it is very important for the researchers to pay attention to the data analysis process and the procedure through which outcomes are calculated.

    Though data collection provides a lot of raw data, but these data are unorganised in nature. By analysing the data, data are organised in such a manner that it provides meaningful answers. **For example**, responses of a survey may be compared to know the number of individuals attending the survey as well as the approaches used by respondents to answer certain questions. Analysed data can be visualised with the help of graphs, charts, tables, etc. the graphical representation of data allows the researchers to rearrange and reorganise the data so as to minimise the effort put by the readers in searching the significant information. By showing the analysed data graphically, presentation becomes easy to understand.

11) **Testing of Hypothesis:** The next step after analysing the data is to test the previously formulated hypothesis. In this step, researchers perform certain statistical calculations to accept or reject the hypothesis. Based on the collected data, a suitable hypothesis about a probability distribution is chosen. This stage comes under the purview of statistics as the analysis is performed with the help of statistical techniques. The prime motive behind testing a hypothesis is to check its accuracy. By testing a hypothesis researchers can check whether it represents the population at large or not, as the hypotheses are formulated on the basis of sample. A hypothesis is said to be accurate if it shows the true differences and does not contain random sampling error. The true difference is measured by testing the hypothesis.

12) **Generalisation and Interpretation of Data:** As the collected data is analysed through different statistical techniques and methods, the final results should be given value and meaning. The meaning and valuation of the results depend upon the process of interpreting results. On the basis of interpretations, various conclusions and generalisations are made. Researchers can generalise the research results if they conduct the testing a number of times, and the outcomes are found similar every time. But, if there is no hypothesis, then the outcomes are explained on the basis of some theories or concepts. This explanation often triggers new issues for further researches.

    Generalisation means applying the findings and conclusions of the research to the actual world. Outcomes from the research can be interpreted in two possible ways:

    i) Drawing inference from the outcomes to develop theories or concepts. In this case, the results are concluded on the basis of a general statement.
    ii) Examining the data empirically and applying it to the larger population. In this case, the general statement is applied to the bigger area.

    The process for developing the general statement is same for both the cases, but the nature of statement differs according to the nature of research problem, i.e., theoretical or empirical. After analysing the data, researchers try to interpret the findings on the basis of theoretical and practical objectives of research.

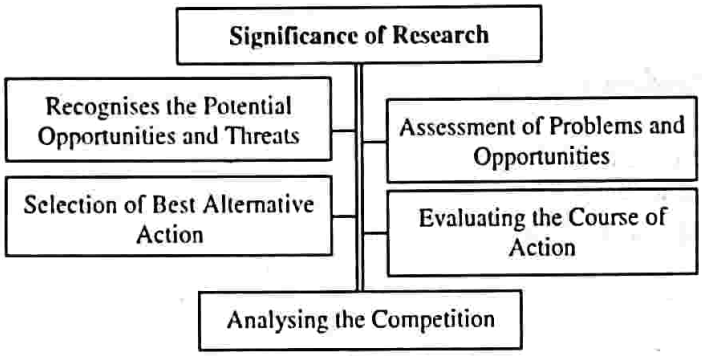
    Data interpretation is a step of research process where the measurements and statistical observations of the study are scrutinised to develop evidences for responding to a research problem.

13) **Preparation of Research Report:** The final step of any research process is the preparation of research report. After collecting, analysing, and interpreting the data, the next task is to compile all the steps and present those phases in a written-form. It includes detailed description of research design, sample design, tools for data collection, and statistical techniques for the analysis of the collected data. Since, research report is very useful for current as well as further researchers, hence proper care must be taken while preparing the report.

Report writing needs skills and knowledge so that appropriate data can be appropriately represented. The report writing skills may be developed through practice, but a researcher should always follow the basic principles of report writing. Some of the important skills needed are clarity, coherence, objectivity, etc. a research report is efficient if it is able to communicate and present the research data. Usually, management as well as the audience is not interested in the details of statistical calculations and its procedures, hence, the researcher should try not to overload the report with such specifics. Therefore, much care is required for the effective preparation of research report to make it useful for the management and audience.

1.1.5. Significance of Research

Research plays a vital role for an organisation as it provides valuable information to the managers that help them in decision-making at various stages of operation. Research helps the management in following ways:


Significance of Research
Recognises the Potential Opportunities and Threats
Assessment of Problems and Opportunities
Selection of Best Alternative Action
Evaluating the Course of Action
Analysing the Competition

1) **Recognises the Potential Opportunities and Threats:** For any strategy to be successful, the organisation needs to have a very good understanding of the environment in which it operates. Research is a tool with which management is able to scan its environment and identify various opportunities and problems existing in the environment. By scanning and researching extensively, management can understand the environmental situations efficiently. This helps to formulate strategies in accordance with the situations to overcome the prevailing problems and exploit the opportunities to the fullest.

2) **Assessment of Problems and Opportunities:** Researching the problems and opportunities help the managers to estimate and analyse them. It allows the managers to identify the existing problems and the factors responsible for the problems. Research facilitates the managers in identifying, exploring, refining and quantifying the opportunities existing in the environment. Alongwith these, it helps in setting the priorities in case of multiple opportunities.

3) **Selection of Best Alternative Action:** Research assists the managers in selecting the best among the alternative courses of action. The various alternatives are evaluated using specific evaluation criteria set by the researcher. Researchers forecast the necessary future activities to be taken with properly analysing the scenario which in turn helps in planning. Research can also suggest the strategies that managers should use in planning properly and preventing it from failing. **For example**, a company can research the best possible strategy for positioning of a product.

4) **Evaluating the Course of Action:** Research can be used to see if the planned course of action has been implemented in way it was intended to. It allows the managers to estimate the extent to which a given activity or project is executed as per the direction. It helps to identify the potential factors that can affect the execution. Research is also carried-out to evaluate and control the strategies implemented for executing the project.

5) **Analysing the Competition:** The organisations need to study the market and the level of prevailing competition in it. To fulfil this objective, organisations conduct research to collect the information regarding the purchasing trends, competitor's strategy, market share of competitor firms, etc. This allows managers to formulate strategies that can help them in achieving their targets. **For example**, Pepsi Co. can conduct a research to know the strategies adopted by Coca Cola.

1.1.6. Limitations of Research

Unlike other nations, in India, the need and importance of research is not yet realised. Hence, it faces several barriers which are as follows:

1) **Lack of Fund:** Researchers need sufficient fund to conduct a research properly. But, companies do not sufficiently allocate funds for the research and development activities. Due to the lack of sufficient fund, several research projects either get delayed or do not proceed further.
2) **No Centralised Database:** There is no centralised database system available for research in India, due to which it is very difficult to find the information about already conducted related researches. The consequence of this barrier is the repetition in research works which is carried-out by different organisations.
3) **No Coordination among Researchers:** Research work requires a strong code of conduct to be followed. The researchers do not follow the norms due to which they have no coordination. This results in difference of opinion among them which in turn affects the quality of research work.
4) **Lack of Library Management:** The libraries in India are not managed properly. There is lack of books, journals, and reports in libraries, due to which the crucial time of researchers are wasted in finding the useful information from available material.
5) **Absence of Ethics in Research:** Researchers in India have no proper knowledge about the domain due to which they copy the material from other research works instead of conducting the research on their own. As a result, the accuracy and validity of the research outcomes are highly unreliable. The absence of ethics in research is one of biggest problem that can be solved by following the ethical norms while researching.
6) **Lack of Proper Contacts between Research Departments:** Research is a well co-ordinated activity of the concerned departments conducting it. The lack of coordination among the researchers of the related departments leads to biasness in the research. Due to this barrier research works lack the huge amount of primary data may remain unavailable to the researchers which may hamper the quality of research.
7) **No Trust on Researchers:** Many of the organisations do not cooperate with the researchers due to lack of trust. Companies show unwillingness to share information, because of the risk of misuse of data.
8) **Lack of Skilled Researchers:** Research is a systematic procedure and requires the researcher to be well-trained in collecting data, sampling and analysis. But, the researchers in India have no expertise in research methodology. Most of the research guides have no knowledge regarding the tools and techniques used in research. This lack of skilled manpower is a big limiting factor in the research environment in India, as it directly affects the reliability of research work being done. Hence, the organisations should train their researchers in specified area of knowledge.
9) **Data Manipulation:** Researchers often manipulate the data to present it the way they want. The reason behind this manipulation is the lack of confidence on the outcome of the research activity. This results in a false picture of a research work and leads to severe impact on both the accuracy and validity of research. The researchers conduct their activities on the basis of mere theoretical knowledge which is not sufficient, since the knowledge of theory and its application are two different aspects. Hence, a proper knowledge of theory as well as correct practical implementation is necessary for a good research work.
10) **Costly Affair:** Printing and publishing the research work proves to be costly for the research associates. If the research paper is to be published internationally then it requires more fund, which is not affordable for many researchers.

1.1.7. Research in an Evolutionary Perspective

The criterion or basis for investigating the world was developed very late. Initial methods of investigation emphasised by the Greek philosophers, like **Aristotle** who claimed that the teeth in both men and women differ in numbers. He gave detailed and comprehensive reasons to support this claim but never examined it. In fact, evidence and not arguments is needed to determine the accuracy of any statement. Therefore, since that time onwards, observations and experiments have started to be undertaken. This meant that the conclusions of the experiments were universal and could be replicated. In this way, evolution of scientific method took place. It was later followed by experiments in the field of behavioural sciences. Similarly, statistics, decision theory, game theory and theories of probability, utility, operations became the basis for social and empirical sciences. Solutions to the common problems of methodology were sought by several scientific philosophers. These problems included validation of induction and nature of scientific explanation.

Before the evolution of research could flourish, a two hundred years long battle took place between emerging empiricism and the established church. Slowly, with the growth of science, the attitude of the Western people began to shift from medieval end towards modernity. This growth became possible due to the efforts of early scientists like **Copernicus** who supported the view that the Earth revolved around the sun based on empirical evidence and challenged the view that Earth was at the centre of the universe. Another scientist **Francis Bacon** believed that experiments and not mere assumptions should be considered as the medium of increasing the level of knowledge. Techniques of mathematics and observation were used by **Kepler** that replaced the Pythagoras theorem and proved that the planets revolve in elliptical orbits. **Galilel** supported the view of Copernicus and hence, was put under house arrest. Another scientist **Descartes** argued that there was a scientific explanation behind the existence of God and human beings. He believed in the Cartesian rationalism that put faith in the existence of God as well as supported experiments and observations. Our understanding about nature and its various patterns was further enhanced by the experiments of **Newton**.

There are several claims which state that the scientific methods are the most convincing form of research. They are unbiased and allow the researcher to not follow the preconceived theories and notions rather one can possibly conduct new experiments in order to examine the accuracy of the conclusions. **Hawking** proposed that the following two requirements should be satisfied by any theory in order to be considered as good one:

1) Certain forecasts must be made by the theory about the conclusions of future experiments.
2) The theory must accurately take into account a large class of observations which should be based on a model comprising less number of random elements.

Hawking believed that a physical theory is a mere hypothesis which is always temporary and cannot be proved. Therefore, there is always a chance that a conclusion will contradict with the theory, no matter the number of times it has agreed with it in succeeding experiments. But, only a single contradictory observation is required to prove a theory wrong. Therefore, it can be said that a new theory is an extrapolation of the former one. Practically, add-ons in the form of modifications and rejections are done in the former theory in order to develop a new one.

To prove the above point, an example can be taken where the gravitational laws of **Newton** were challenged by the predictions of **Einstein**. The theory of gravitation given by **Newton** in 1666 is among the greatest rational discoveries of all time. Each and every observed fact was explained in this theory. It also made forecasts which were tested and found accurate later on, under the assumption that the instruments used to test were accurate. But, certain discrepancies were found in this theory of **Newton** in the 19th century when more accurate testing instruments were used. After this, **Einstein** opposed the theory of **Newton** and gave his own theory of relativity. However, this does not mean that there is a difference in the truth discovered by both **Newton** and **Einstein** for the same universe. It simply means that all the experimental evidences at that time agreed with the theory, thereby proving it to be true.

A new theory is developed by the researchers every time an old theory is unable to prove new data. This is not an easy task in the time where knowledge is increasing and the new theory proposed has to include the results of past researches as well as prove the new data. In fact, researchers have to study and reject a lot of assumptions and hypothesis before formulating a new theory. Discussions are conducted regarding the validity, various hypothesis (formed on the basis of distinct assumptions) are approved and later on rejected. **For example, Copernicus** proposed that the planets of our solar system revolve around the sun in a circular motion, but according to **Kepler**, they revolve in an elliptical form. After carefully examining the revolution pattern of the planets, it was found that Kepler's theory was more accurate and the planets actually revolve in ellipses. Hence, the theory given by **Copernicus** was replaced by the one given by **Kepler**. However, it is possible for different theories to have similar forecasts. If the new experimental evidence contradict with the forecasts of a long accepted theory, then it might be rejected based on the explanation of reality. However, such theory might still be applicable under certain limitations. **For example**, the theory of relativity given by **Einstein** replaced the laws of motion given by **Newton**. This was because Einstein's theory gave a more accurate and general understanding of the universe.

Creation of knowledge is an age old concept and it forms the basis for the development of society. The researches that are conducted leads to new inventions and discoveries. It also assists in technology development and provides fresh knowledge and guidelines.

1.2. BUSINESS RESEARCH

1.2.1. Meaning and Definition of Business Research

Research conducted for describing the business problem(s) of a particular business, is called **Business research**. **For example**, in order to start a particular business it is very crucial for the entrepreneur or the owner to have information about the type of customers and nature of competition in the market. It helps in designing business plan for the organisation. All these information can be availed only through the business research. It plays a key role in deriving consumer demand for the existing business.

The scope of business research covers small topics (like finding an idea and a name for the business) as well as big and thorough topics (like collecting information about consumer demand, buying trends, competitor analysis, etc.). In fact, the overall business research process is focused to help business through collecting important information from the market.

According to McDaniel and Gates, "Business research is the planning, collection and analysis of data relevant to business decision-making and the communication of the results of this analysis to management".

According to Zikmund, "Business research is a management tool that companies use to reduce uncertainty. It is a manager's source of information about organisational and environmental conditions, and covers topics ranging from long-range planning to the most ephemeral tactical decisions".

1.2.2. Nature of Business Research

Following are the points related to the nature of business research:

1) **Systematic and Organised:** Business research is very systematic and organised in nature. It involves well organised and planned process in which a particular research is conducted. The researcher has to follow every step in order to attain appropriate conclusions from his research.

2) **Objective Approach:** It can be said that business research has an objective approach, since every research conducted here is having a set purpose which has to be achieved. **For example**, the business may be having certain problems for which research is conducted to arrive at the detailed solutions of the concerned problem.

3) **Applied in Nature:** Business research is an applied research derived on the basis of social sciences and various academic observations of the related researchers. As it understands as well as solves different business related issues, it can be said applied field. It assists managers in identifying and solving different managerial problems.

4) **Involves Lengthy Fact-finding Exercises:** Business research is characterised by lengthy fact-finding exercises and uses the guidance provided by various theories. This means that the observations (which are based on facts) derived from various researches, undergo deep analysis for arriving at a certain conclusion. Proper analysis and interpretation is done before making any conclusion.

5) **Problem-Oriented:** Being a part of applied research, business research is problem-oriented which aims at attaining information related to a particular problem. Such information helps in solving the business problems of specific nature and also supports the decision making process.

6) **Conducted in a Dynamic Environment:** The business environment is of dynamic nature which keeps changing on frequent basis. It may happen that the answers derived by the researchers regarding current questionnaires may differ entirely from tomorrows findings, this happens due to the constantly changing environment in which research is undertaken.

   In such conditions, the mangers are required to maintain flexibility with the dynamic situations. Here, the same questions may be required to ask on repeated basis, therefore the successful organisations have set a culture where business research has become an essential part of various business operations and is conducted on regular basis.

1.2.3. Objectives of Business Research

Following are the objectives of business research:

1) **To Estimate Expenses:** Business research is useful in estimating expenses for a business especially new one. Generally, the expenses of a new business overflow the estimated amount. Without having information about the true cost of production it is not possible for the owner or entrepreneur to decide the prices of organisational products and services. Therefore, business research is used by owners so as to deal with such problems. It includes collecting information about different aspects of production like business licences, raw materials, packaging, warehousing, etc.

2) **To Determine Prices:** Another factor proving to the need of studying business research is price determination in organisations. Ineffective pricing strategies may lead the organisation out of competition. It is very crucial for the organisations to have appropriate pricing strategies. Therefore, owners rely on business research so as to design their pricing policies. Business research can be used to observe competitors' pricing strategies as well as their product attributes. It can also be used to collect the consumer feedback about different competitors' pricing strategies. In short, business research prevents the business from unnecessary roadblocks due to poor pricing policy.

3) **To Assist Managers in the Decision-Making Process:** A manager of a business organisation has to take several decisions so as to keep the business moving. He needs a smooth flow of different operations in the business so as to make effective decisions. Customer and dealer satisfaction, competitive positioning, marketing strategies, etc., are the areas where a manager has to take effective decisions for survival and growth of the business. Business research enables the manager to take relevant decisions for different aspects of the business. It collects useful information from within as well as outside the organisation to support the decision-making ability of the manager.

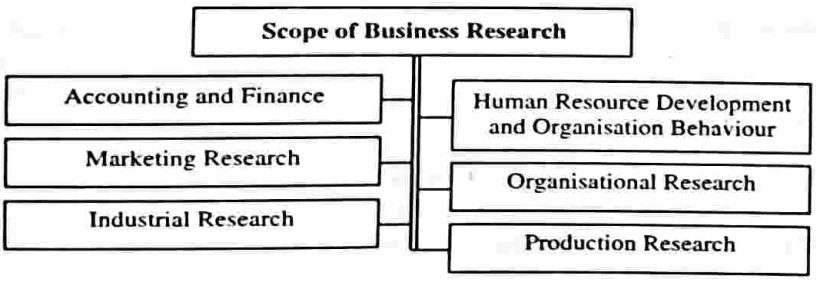
4) **To Evaluate Market Trends:** Market trend analysis is very important for new as well as established businesses. It helps in understanding the working of the market and trends which are currently popular in the same. Managers want to know the prevailing trends in the market so as to design new products, services or to deal with new projects in hand. Without having in-depth understanding of the current market trends it is not possible for the organisations to survive in the competitive environment. Business research helps in collecting information from the market so as to determine the market trends. Different tools and techniques like questionnaires, schedules, surveys, observation, etc., are used for this purpose. It helps in determining the size of the market so as to ensure whether it is profitable to sell organisational products and services in it.

5) **To Achieve Competitive Advantage:** In presence of severe competition it is very crucial for the businesses to design competitive strategies and policies for their products and services. For this, organisations need to observe and analyse different marketing techniques of the competitors available in the market. Business research helps managers to gain insight of different competitive policies and strategies of competitors.

   It helps in exploring the media channels and promotion tools used by different players in the market. For example, different organisations are using social media as a channel for their promotion. They use variety of tools and software to support such activities. Business research helps in identifying these tools and techniques alongwith their effectiveness.

1.2.4. Scope of Business Research

Business research can be conducted either to discover or explain a theory or to solve a specific problem faced by management. Various areas of management in which business research is carried-out are as follows:



1) **Accounting and Finance:** Some of the main areas where research is conducted in the field of accounting and finance are :
   i) Budgetary control systems,
   ii) Designing new practices and methods for inventory costing,
   iii) Treatment of depreciation and its effect on earnings,
   iv) The practice of transfer pricing and its effects on profitability,
   v) Individual's attitude towards investment decisions,
   vi) Decisions regarding capital structure and capital budgeting, and
   vii) The effect of mergers and acquisitions on profitability.

2) **Human Resource Development and Organisation Behaviour:** The areas of human resource and organisational behaviour are some of the core domains of research. Some of the important issues in which research studies are carried-out are as follows:
   i) Individual behaviour and interpersonal relations,
   ii) Attitudes of employees,
   iii) Leadership characteristics and styles,
   iv) Mechanisms used for performance appraisal, and
   v) Assessment centre and evaluation.

3) **Marketing Research:** There is widespread use of research in marketing. The company bases all of its marketing strategies and initiatives on the basis of consumer tastes and preferences, which can be understood with the help of various researches conducted to get an in-depth knowledge about it. Marketing research can be carried-out for varied like consumer behaviour, consumer attitudes, advertising effectiveness, distribution channel efficiency, sales analysis, new product development, etc.

   Some specific examples of marketing research are:
   i) Forecasting the demand for products,
   ii) Analysing the buying behaviour of consumers,
   iii) Measuring the effectiveness of advertising,
   iv) Decisions regarding media selection for proper advertising,
   v) Market testing for new products,
   vi) Decisions related to positioning strategies for a product, and
   vii) Estimating the product potential.

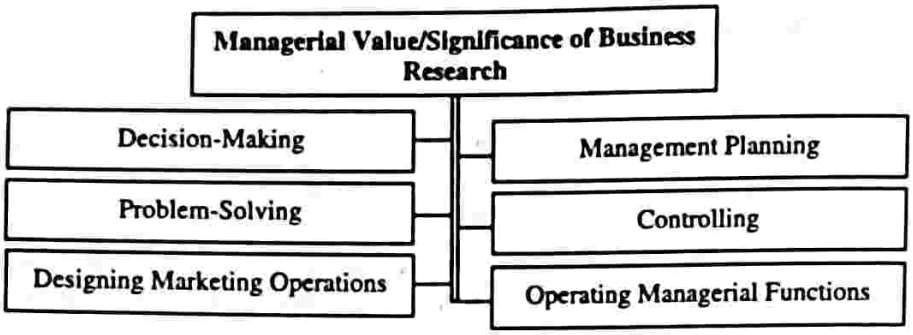
4) **Organisational Research:** The organisational research is a field that constitutes many disciplines. In an organisation, researchers come from different backgrounds and hence bring various concepts, tools, and methods for research. It is widely being accepted that the knowledge of research methods is useful for the students who aspire to become managers in future. Organisational research facilitates the managers to explore various theories and findings that are relevant for the organisation. It also helps the managers to increase their problem solving efficiency. Knowing the research fundamentals allow the managers to investigate a problem scientifically, which in turn enhances the efficiency of managers.

5) **Industrial Research:** Industrial research is a practical concept and is concerned with the wellbeing of a company. It is a planned effort to gain better information and improve the new and existing products, services and processes. Some of the major areas where industrial research is carried-out are:
   i) Finding ways to improve the quality of products and services,
   ii) Developing new products and services to gain market share,
   iii) Devising new ways to use the available resources,
   iv) Decisions regarding minimising the cost,
   v) Ways to reduce hazards at workplace,
   vi) Standardisation of processes, and
   vii) Developing strategies for improving the relations with customers and public.

6) **Production Research:** The production function in an organisation is dynamic in nature and needs continuous improvement in process, product design, cost etc. But these changes and improvements lead to some complexities, which can be resolved by production research. Production research is conducted in following areas:
   i) Finding new and better production methods,
   ii) Ways to standardise and control the production, and
   iii) Finding strategies and methods for troubleshooting.

1.2.5. Managerial Value/Significance of Business Research

Managerial value/significance of business research is as follows:



1) **Decision-Making:** Business research facilitates decision-making in the organisation. By providing analyse and processed information about the market, consumer or the business environment, it helps managers i taking crucial marketing decisions. As variety of new technologies and competitive strategies ar developing every day in the market, it is very necessary for the managers to use business research as supportive tool in decision-making.

2) **Management Planning:** Another role of business research is to aid organisations in management planning Different opportunities available in the market are explored by business research and some promising one are selected by the management. Thus, management designs organisational objectives and utilises usefu resources for its planning.

3) **Problem-Solving:** Business research also assists managers in solving different management problems. A manager faces decision related problems with respect to the marketing mix elements of the organisation. Different short-term as well as long-term decisions have to be taken by the manager so as to make the marketing of the organisation effective and competitive. For a particular business problem, different alternative solutions are developed and evaluated by business research.

4) **Controlling:** Business research is also used as a controlling technique for the organisation. It helps in controlling as well as managing different plans and policies of the organisation by exploring defective or poor management decisions within the organisation.

5) **Designing Marketing Operations:** For any organisation marketing as well as production operations are the key tools for generating revenue from the market. Here, production operations focus on reducing cost of production, whereas profit maximisation is the aim of marketing operations. Information collected through business research helps in effectively determining marketing as well as production operations.

6) **Operating Managerial Functions:** Different business functions are based on the information from the market. This information is collected through business research methods. Therefore, it helps in operating different managerial functions like forecasting, planning, motivating, coordinating, controlling, evaluation, etc.

1.2.6. Factors Affecting Business Research

There are numerous factors that affect business research. Some of these factors are:

1) **Reliability and Validity of Secondary Data:** The degree of validity and reliability of the secondary data used influences the research. A lot of variation can be found in the accuracy of the secondary data across different nations. This could mean that the methods used to collect primary data are inaccurate, biased or does not have the ability to make comparisons across different nations.

2) **Social and Cultural Factors:** These are another important factors influencing research. Therefore, the researcher, while gathering the primary data has to take into consideration the various cultural and social factors that affect the evaluation of different methods of collection of data.

3) **Availability of Sufficient Data:** Data also highly affects the research conclusions or results. Sufficient and reliable data should be available for conducting efficient research. Non-availability of data from reliable sources might hamper the process of research. It can also influence the deductions and measurements.

4) **Nature of the Research Questions:** Research is also influenced by the nature of question associated with a particular research. The nature of questions to be asked in order to collect data should be consistent with the method of collecting data. **For example**, surveys should be conducted in order to address questions related with quantity. Similarly, the methods of field research and case studies should be used to get an understanding of the decision-making of an organisation.

5) **Nature of the Research Setting:** The nature of the research setting also affects the process of research. The setting could be an organisation, learning centres, hospitals, shopping centres, etc. The researcher has a less role in choosing a setting. **For example**, a lot of applied researches are conducted in actual world scenarios.

6) **Resource and Time Constraints:** Every process of research is affected by the limitations of time and budget. **For example**, applied researches have to completed within the given timeline and budget of the client as described in their project.

7) **Usefulness:** The usage of the findings of applied research is a matter of concern. Researchers need to be careful in choosing a research design that should provide the answers to the questions. Also the questions need to be asked in an appropriate manner.

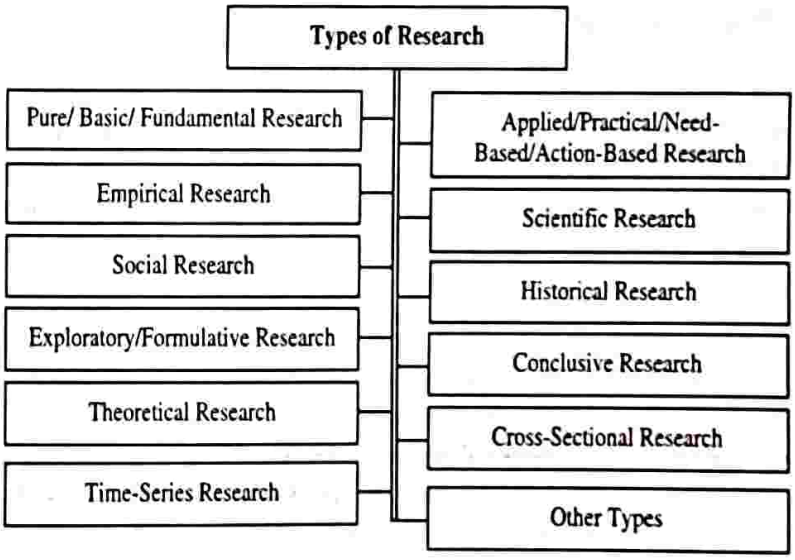
8) **Availability of the Financial Resources:** A good research is dependent on the availability of money. Generally, organisations allocate the major part of their budget for R&D activities. Therefore, availability of adequate amount of financial resources is essential for conducting research in the right way.

9) **Researcher's Value:** The values possessed by the researcher also influence the research process. It impacts the decision regarding the problem that needs to be answered in the research as well as the methodology opted for conducting the research. Researcher's assessment is usually influenced by his individual perception towards the subject matter.

10) **Knowledge of Research Tools:** Conducting a research requires the correct and proper knowledge of different statistical research tools on the part of the researcher. Application of inefficient research tools will produce unreliable results so in order to carry out a thorough research sophisticated research tools are essential.

1.3. TYPES OF RESEARCH

Various types of research are classified as follows:



1.3.1. Pure/Basic/Fundamental Research

Pure research is also known as "basic research" or "fundamental research". It is the most basic form of research. The objective of this research is to provide models and theories regarding some phenomenon. This type of research seeks to obtain knowledge about a particular subject rather than its practical usage, testing of hypotheses and theories. Basic research is carried-out to discover and gain better insight about a specific phenomenon, without considering the problem and its direct practical application.

For example, designing a research model for reading behaviour among teenagers has no practical application and it simply contributes to the area of knowledge.

Basic research can take one of the following forms:

1) **Discovery:** When the objective of a basic research is to discover, then it tries to find new explanations or ideas about a particular issue based on empirical evidences. **For example**, the theory given by Charles Darwin on "the survival of the fittest".

2) **Invention:** Designing new methods and techniques can be the prime purpose of basic research. **For example**, inventing the concept of total quality management.

3) **Reflection:** Here, the researchers analyse the theories, models, or techniques in some different organisational or social contexts. **For example**, applying the concept of Herzberg's Two Factor Theory on Indian Army.

1.3.2. Applied/Practical/Need-Based/Action-Based Research

Applied research is also called as "practical research", "need-based research" or "action-based research". While basic research emphasises on enhancing the existing knowledge without any practical application, applied research on the other hand, applies the existing knowledge, theories, and methods to solve particular issue. Basically, it is the practical application of the concepts provided by basic research.

It tries to solve the existing problems faced by businesses, society, and government. Applied research tries to provide the solutions to eradicate the various types of practical problems related to real life and social life.

For example, when a sociologist tries to find out the reason for crime, or the factors that lead a person to become criminal, is the area of pure research. But, when the sociologist tries to find out how the behaviour of a criminal can be controlled, it falls in the purview of applied research.

1.3.3. Empirical Research

Empirical research is data-oriented. This kind of research provides insights through observation or experiences. In this research, the primary data are collected, analysed and tested to prove some hypotheses. Empirical research can be conducted through both the qualitative and quantitative approaches. **For example**, Major researches conducted on health issues usually adopt empirical research.

Instead of theories, empirical research is based on observation and measurements. It attempts to develop new ideas by collecting primary data. Hence, the basic difference between theoretical and empirical research is that, in theoretical research the researcher arrives at the conclusions based on existing literature, while in empirical research the researcher takes a step further and collects the data to test the theory. **For example**, measurement of noise pollution in cities to find out the exposure to sound faced by the citizens.

1.3.4. Scientific Research

Scientific method refers to bodies of techniques for investigating phenomena, acquiring new knowledge or correcting and integrating previous knowledge. To be termed scientific, a method of inquiry must be based on gathering observable, empirical and measurable evidence subject to specific principles of reasoning. A scientific method consists of the collection of data through observation and experimentation and the formulation and testing of hypothesis.

Although procedures vary from one field of inquiry to another, identifiable features distinguish scientific inquiry from other methodologies of knowledge. Scientific researchers propose hypothesis as explanations of phenomena and design experimental studies to test these hypothesis. These steps must be repeatable in order to dependably predict any future results. Theories that encompass wider domains of inquiry may bind many hypotheses together in a coherent structure. This in turn may help form new hypothesis or place groups of hypothesis into context.

1.3.5. Social Research

Social research may be defined as a scientific undertaking by means of logical and systematised techniques. It consists of the process of formulating and seeking answers to questions about the social world. Social research is fundamentally a scientific enterprise aims to:

1) Discover new facts or verify and test old facts;
2) Analyse their sequences, inter-relationships and causal explanations which are derived with an appropriate theoretical frame of reference;
3) Develop new scientific tools and theories which would facilitate reliable and valid study of human behaviour.

Social research is a systematic method of exploring, analysing and conceptualising human life in order to extend, correct or verify knowledge of human behaviour and social life. Social research seeks to find explanations to unexplained phenomena, to clarify the doubtful and correct the misconceived fact of social life.

It involves the application of scientific method for understanding and analysing of social life in order to correct and verify the existing knowledge as a system. The main idea behind social research is to discover new inter relations, new knowledge, new facts and also to verify old ones. Human behaviour may be involved by certain values and laws. The main purpose of social research is to discover those laws which can be proper guidelines for studying human contact and behaviour.

1.3.6. Historical Research

Historical research is an organised attempt to collect the data regarding historical events, analysing them, and interpreting the events. It is carried-out to identify the causes, effects, and trends regarding past occurrences to improve the present and future. Many modern practices and techniques can be developed and improved with the help of historical data. Usually, the approach used for historical research is qualitative in nature, but, sometimes quantitative measures can be adopted. Historical research tries to identify the past forces that affect the present. An example of historical research can be finding out major earlier organisational practices that can be implemented in contemporary organisations.

1.3.7. Exploratory/Formulative Research

Exploratory research is also known as "formulative research". The basic objective of this research is to explore the unknown facts or phenomena that are not previously defined. In exploratory research, researchers seek to gain better knowledge about a situation, and formulate new concepts and theories by developing and testing hypotheses.

A hypothesis becomes difficult to be formulated when the theory is too general or too specific. Here, exploratory research is needed to obtain the knowledge that is useful in developing hypothesis, so that further investigation can be performed. Exploratory research helps the researchers to find out the best research methods, research designs, and data collection techniques for various research objectives.

For example, exploratory research can be used to determine the reasons behind the higher terrorism rate in a country than other nations.

1.3.8. Conclusive Research

In contrast to exploratory research, larger sample sizes, modern analytical tools and statistical methods are utilised in conclusive research. With the help of this research different alternatives can be identified and evaluated and the best one can be selected concerning the given situation, thus, it supports the decision-maker. Two major categories of conclusive research may be descriptive and causal.

1.3.8.1. Descriptive/Statistical Research

Conclusive or descriptive research can be defined as the research that tries to explain the characteristic features of the population under study. This research is based on the concept of 'reflective thinking' that discusses about the objectives and assumptions regarding a research study. Descriptive research is concerned with answering the questions like who, what, when, where, and how regarding a phenomenon or situation. It can be carried-out on all those areas which are quantitative in nature. The descriptions in this research are used to calculate the frequencies, averages, central tendencies, etc. Sometimes, it is better to conduct a survey before carrying out the descriptive research.

For example, a research can be conducted to examine the causes behind a specific kind of disease in a particular area.

1.3.8.2. Causal/Experimental/Explanatory Research

Experimental research, also called "causal research" or "explanatory research", is carried out to identify the causes behind any effect. It determines the effects on dependent variable due to the changes in independent variable. In experimental research, two similar groups are chosen for measuring the experimental effects. The group which is exposed to treatment is called the 'experimental group', and the group which is kept constant is called 'control group'. After the treatment is imposed on the experimental group, the effect is measured by comparing it with control group. The treatment effects are thus identified. The outcomes of the experimental research are not always straight and direct due to the variability factors. Hence, to measure the results accurately, it is necessary to keep the control group constant while modifying experimental group.

For example, a primary school teacher may want to evaluate a new technique for teaching mathematics in comparison to the standard teaching method.

1.3.9. Theoretical Research

Theoretical research seeks to add new knowledge by discovering new ideas and theories with the help of existing theories and explanations. But, the major emphasis is on studying rather than testing the theories and models. In other words, it is based on secondary data instead of primary data.

Besides many benefits, theoretical research has always been the subject of criticism. The reason behind various arguments is that theoretical research has no test component. Many researchers say that theories are easy to formulate without the need of evidence, which is why it should not be considered as a proper academic research. But, the basis of this argument is not true. Every research needs conceptualisation. Theoretical research strives to gain knowledge about the existing theories to improve the body of knowledge through addition of value to it. **For example**, an organisation may conduct a research on its employees and their motivation levels based on Herzberg's two-factor theory.

1.3.10. Cross-Sectional Research

Using sample of a given population to explore its features is called 'cross-sectional research', only if the sample is used once in a time. Different entities like individuals, retail stores, dealers or households can be used as samples. Generally, cross-sectional study is used for descriptive research purposes. **For example**, in order to determine the attitude of different scholars on the issue of adding an internship curriculum to the course of a degree program, cross-sectional study would be helpful as the attitude of scholars are measured once. Cross sectional research is also called 'snapshot' of the target population as measurement is done only once.

Most of the organisations use cross-sectional studies to test their advertising and its effect. **For example**, a 'storyboard' is prepared by organisations to test their advertisements. Storyboard is made-up of proposed advertisement copy and drawings of major clips of the proposed ad. After showing the storyboard to a small group of customers, few relative questions are asked to determine if the ad is clearly understood by them or not. Their level of interest is also measured. Customers' reactions help organisations in determining the effectiveness of ad copy, ad appeal or its creative contents. A typical question intended to measure the intention of customers to purchase the proposed product is also asked.

Small as well as very large samples can be used for cross-sectional research. These samples may or may not necessarily be representatives of any larger population. When large-sized samples being representative of any larger population are used in cross-sectional research, these are called 'sample surveys'.

Two types of cross-sectional researches are found:

1) **Single Cross-Sectional Research:** In this a single sample of the larger population is used only once for data collection.
2) **Multiple Cross-Sectional Research:** In this, more than one samples are selected from the larger population and data is collected only once from each of the samples. Often, a long time gap is taken in collecting data from different samples.

1.3.11. Time-Series Research

Time-series research is based on collection of data at fixed intervals, based on same variable in the form of aggregate measures of a population. This fixed interval involves collecting data daily, weekly, monthly, quarterly, or on yearly basis. All variables are measured over different periods of time. Due to this, the researchers can measure any change occurring in the variables over the given period of time. **For example**, unemployment and poverty rates, the FBI uniform crime rate, the Consumer Price Index and so on.

Time-series research designs can be used in:

1) Formulating a standard measure,
2) Explaining the changes in the variables over a given time,
3) Making a note of trends, and
4) Predicting trends of future (short-termed).

Chart and graphs are used to represent the data of time-series. The x-axis shows the different intervals of time whereas the y-axis represents the different fluctuating values of the dependent variable.

The graph of a time-series usually shows four distinct trends and patterns:

1) Long-term trends which increase or decrease over a given time period.
2) Cyclical variations that have short-term, peak-to-peak or valley-to-valley cycles.
3) Seasonal variations which occurs due to changes in seasons, e.g., holidays or weather conditions.
4) Irregular fluctuations

1.3.12. Other Types

Besides above mentioned research types, there are some other types of research also:

1) **Evaluation Research:** Evaluation is defined in many ways as per the objective of the research study, the techniques applied, or the application of outcomes. Usually, it can be defined as the systematic measurement and judgement about a situation to provide the feedback. The evaluation is always based on some criteria. The most common criteria used for evaluating an object are benefits, efficiency, sustainability, applications, etc.

   Generally, the emphasis of evaluation research is on the utilitarian benefits of an object. It strives to understand an activity or an object by assessing and examining it, based on some criteria. In other words, it is a comparative analysis, where the original objectives of study are assessed to determine their way of accomplishment, so that it can be improved. It can also take the form of summative study, where conclusions are made to infer the shortcomings of the study. **For example**, a manufacturing firm can evaluate its performance after using just-in-time method in its production system.

2) **Action/Participatory Research:** Action research is also called as "participatory research", where active problem-solving is done by the individuals of a team in an organisation to improve the method of solving issues. In this process, the employees of an organisation contribute collectively to bring the change through the research process.

   Action research is also practiced by big institutions to enhance the strategies and techniques adopted by them for their operations. Action research is an organised form of investigation which is collective and evaluative in nature. It tries to correlate the problem-solving methods with the research or analysis so that future changes in an organisation can be predicted. **For example**, a research can be conducted to know the best applicable method for certain type of students.

3) **Ex-post Factor:** Ex-post factor research is a systematic effort to trace-back the causes resulting in specific effect. In this research, the actions that has caused the effects are identified, which are then imposed on some other similar set of circumstances. It is conducted after the completion of a phenomenon or occurrence. Ex-post factor research is a scientific analysis of independent and dependent variables. Since, the phenomenon has already occurred, therefore, the researcher has no direct control over the independent variables causing the effects. Thus, the conclusions regarding the variables and their relations are made without direct involvement. **For example**, forensic research department may attempt to find the causes for certain crime.

1.4. RESEARCH PROBLEM

1.4.1. Introduction

Among all research activities, defining the research problem is considered as the most crucial and important step for conducting a research. A common statement which defines the issue, upon which a research is to be conducted, is known as a research problem. It proposes the line of investigation which is taken by the researcher for conducting a research. A research problem usually includes areas of researcher's concern, any modification or improvement that the researcher wants to create, any problem or difficulty that has to be resolved by researcher, answer of any unanswered question, handling an undesirable organisational situation, hurdle against management of the organisation, etc.

Thus, in simple terms, a research problem is the set of unanswered questions that the researcher wants to answer, explore and study. This set of questions can be theoretical or practical in nature, depending upon the research and the type of problem. **For example,** if a researcher wants to study the impact of telecommunication industries on a particular region, then he will answer questions such as consumer perception about telecommunication technology, their preferences among different modes of communication, benefits and problems received from telecommunications, etc.

The research problem should always be defined in a comprehensive and precise form. When a research problem is correctly defined, half of it is resolved therein. The right direction of conducting a research is established through a well-defined research problem.

Alongwith properly prioritising the available resources, a researcher can also accurately plan the information requirements through a research problem. **For example,** an exploratory research will be conducted, if a researcher wants to find and explore the causes of declining sales of a firm.

1.4.2. Components of Research Problem

The three main components of research problem are as follows:

1) **Individual, Institution or Community:** A research problem can be centred towards an individual, institution or community. **For example,** if a researcher is finding new techniques of financial management, then the research is limited to the finance department of the company.

2) **Objectives for Pursuing the Problem:** A research problem has some certain objectives or reasons due to which the research is carried out. These objectives make a research purposeful, enthusiastic and attractive.

3) **Lines of Action:** For overcoming the research problem, the researcher needs to pursue at least two lines of action.

1.4.3. Identifying Research Problem

Before defining, the researcher needs to identify and understand the research problem. Although, it is one of the fundamental steps in research, but it becomes very difficult for the researchers to identify problems at times during the initial stages.

Generally, a research problem should be considered as some difficulty, obstacle, vague situation that is being faced by the researcher and for which he seeks solution. This difficulty could be a theoretical or a conceptual problem.

For example, for students it could be a problem of choosing the specialisation area. It is therefore very necessary that before choosing the research activity the researcher should be clear on what is the area in which the research is to be undertaken. For the students, the areas of specialisation can be of education, social sciences, business administration, etc.

A research problem can be identified from various sources, such as own experience of researcher, survey of literature, social issues, etc. Hence, research can be conducted to understand or clarify an existing theory, to explain the contradictions in the existing theory, to rectify the errors in current methodology or to resolve the current problems being faced.

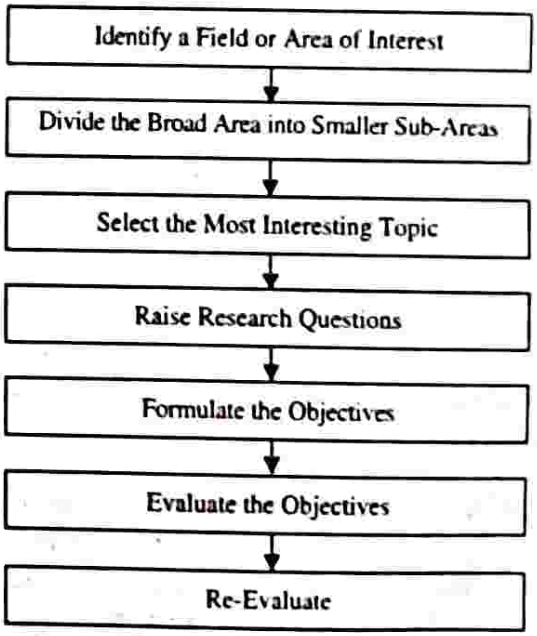
1.4.3.1. Major Sources for Identifying Problem in Business Research

Basically, the researcher's interest level in the research activity helps in identifying the research problem. However, there are several other factors which can also help in the problem formulation:

1) **Experience:** Experience plays a big role in identifying the research problem. **For example**, the experience of doctors plays a very big role in the identification of problems which are faced by patients in clinical care.
2) **Literature:** Researchers also get a lot of ideas by studying books and articles which pertain to the same area in which the research is being undertaken. Researchers also get ideas from other previous research activities done by other researchers.
3) **Social Issues:** Researchers can get an idea of the research problem by looking at social issues at the regional, national or global levels which are influencing the society at large. **For example**, gender issues, education issues, social equality issues, etc.
4) **Political Climate:** A political environment which focuses on cost improvement and enhancement in the social standards also plays a major role in generating ideas for research problem formulation.
5) **Theories:** Research problems also arise when a new and untested research theory is tested for validity.
6) **Ideas from External Sources:** Researchers also get ideas from other researchers, administrators, nurses and field visits regarding the research problem.
7) **Intuition:** Researchers also get ideas about research problem through a process of inspiration or often from their intuition.
8) **Research:** Research ideas also come when the research activity is carried-out on an existing problem.
9) **Brainstorming:** Discussing intensely in a group, a process known as brainstorming, also leads to the generation of many research problems that the researcher can undertake to investigate.
10) **Practical Needs:** Practical needs also give rise to research problems. **For example**, many research ideas come from clinical practise.
11) **Empirical Interest:** An exposure to a phenomenon or event which has not been observed by other researchers also gives the researcher an insight into a new research problem.
12) **Popular Conceptions:** Research needs also arise by studying many practises which exist because of popular beliefs and conceptions. This has been seen in areas like healthcare and clinical practise.

1.4.3.2. Problem Identification Process

The research problem identification process has several steps. These steps assume that the researcher has an understanding about the research topic. By reviewing the existing literature on the topic, the researcher can get an in-depth understanding about the area. Without this knowledge, it will be very difficult for the researcher to dissect and analyse the research problem. The steps involved in problem formulation are as follows:


Identify a Field or Area of Interest
Divide the Broad Area into Smaller Sub-Areas
Select the Most Interesting Topic
Raise Research Questions
Formulate the Objectives
Evaluate the Objectives
Re-Evaluate
Figure 1.2: Problem Identification Process

Step 1: Identify a Field or Area of Interest: In the first step of problem formulation process, the researcher needs to inquire himself regarding his basic area of interest. This will help him in finding a good topic for research. **For example**, if the researcher is interested in social studies, then topics like gender equality, youth violence, employment generation, etc., will be of interest to him. On the other hand, if the researcher is interested in marketing, then the areas like consumer behaviour, social media marketing, advertising, branding, etc., will attract him for research.

Step 2: Divide the Broad Area into Smaller Sub-Areas: By identifying his areas of interest, the researcher will be able to identify the broad areas under which the research can be done. However, these areas will have too many aspects and it will not be possible to cover all these areas under one study. Therefore, the researcher

will need to identify the sub-areas within the overall topics like consumer behaviour or community health. In this, he can also take the help of subject experts and existing literature in the field of study. Once he has generated a list of sub-areas, then he can choose the topic that is relevant to him.

Step 3: Select the Most Interesting Topic: It is neither possible nor cost effective for the researcher to study all the sub-areas have been identified. Out of the various areas that were identified in the last step, the researcher needs to select the sub-areas or topics about which interests him. His interest in the research topic should be paramount in the selection of the topic. However, there can also be other considerations in the selection of a research topic.

The researcher should therefore examine the list of sub-areas and remove all those topics in which he has least interest. After a stage, it will be very difficult for the researcher to further remove topics from the list. The researcher should continue this activity until he is left with a set of topics about which he is passionate and that can be managed within the allocated budget, time and other resources. Once this step has been completed, the researcher is ready to go to the next step.

Step 4: Raise Research Questions: In this step, the researcher decides the issue or problem that he wants to investigate. For this task, he needs to generate and list down the questions that he wants to ask within this area of interest. If there are so many questions in that particular topic which is not possible to manage, then he needs to repeat the process of elimination once again in order to search for another topic for research. This may bring the number of questions down to a manageable level.

Step 5: Formulate the Objectives: In this stage, the researcher needs to list down the various objectives and sub-objectives. The objectives will emanate from the research questions that the researcher has formulated in the first step. The prime difference between the objectives and research questions depends on the way they are framed. Research questions as the name indicated are in a question form. Objectives on the other hand, transform behavioural items into action-oriented terms like "find out" or "to determine" or "to estimate". Researchers often take the reverse process in which they frame the objectives first and then decide the research questions. Some researchers only limit themselves to research questions and do not frame research objectives at all.

Step 6: Evaluate the Objectives: As soon as the research questions have been framed, now the researcher needs to evaluate the objectives in terms of feasibility. He should consider giving his constraints of time, resources (both in the form of human and financial) and the technical skills required to achieve them.

Step 7: Re-Evaluate: In the final step, the researcher should revisit the initial step and ask himself if he is still interested in researching the topic and whether he has the requisite resources to undertake the activity or not. He should question himself regarding his interest and expertise needed to complete the research project. If the answers to these questions are negative, then he needs to reconsider his research activity and should assess the objective once again.

1.4.3.3. Criteria for Identifying Problem

Various factors that jointly formulate criteria for identifying the research problem are as follows:

1) **Unique and New:** The research problem should be new and unique in itself. The researcher should make sure that the research objective is not being repeated.

2) **Importance in Implementation:** The criterion of importance implies the level of criticality of the investigation process, the timelines and how practical the research activity is in terms of implementation and results. Scientific research in the field of education, psychology, etc., has a great role to play in bringing about change in social dimensions and humanity.

3) **Should Provide Knowledge:** The research problem should assist in providing new knowledge, discovering new facts and understanding new concepts and theories. Therefore, the research problem should contribute to the existing knowledge.

4) **Accuracy, Objectivity and Verifiability:** The data which is available must meet the guidelines of accuracy, objectivity and verifiability.

5) **Supported by Equipment and Working Conditions:** Those research problems should be selected that can be supported by essential equipment and working conditions. It would help in bringing out the control and accuracy in the research activity.

6) **Sponsorship and Top Management Support:** A researcher should select only those research problems that are backed by better sponsorship and top management support.

7) **Costs and Returns:** The researcher should also keep in mind his financial resources while undertaking the research activity and the potential returns that he can get from the research activity.

8) **Time-Frame:** A research problem should be selected keeping in mind the time-frame it would require in completion. If a research takes more than the allotted time, then it should be ignored and it fits within the constraints, then only it should be selected.

1.4.3.4. Precautions in Identification of Research Problem

Researchers should take following precautions while identifying the research problem:

1) The words used to define the problem should have a definite meaning.
2) The problem statement should be to the point.
3) The hypotheses should to be recognised for the study.
4) The problem which is being researched should have practicality in the field of research for which it is being undertaken.
5) The problem definition should have a rational basis.

1.4.4. Defining the Research Problem

After identifying and formulating, defining the research problem is one of the most important stages of the research process. This often acts as the foundation of the research process. Without properly defining the research problem, the process of research cannot progress smoothly. It becomes quite difficult for the researchers to design and execute a research activity without having a clear understanding of the research objectives.

Defining the research problem is not only about choosing a research problem, but it implies analysing the topic, pulling it apart and giving it a new shape or dimension so that some kind of data collection and analysis can be done on it. The research problem definition also helps in eliciting the quality of answers from the respondents. A quantitative methodology chooses a deductive approach in reaching the hypothesis that has to be tested. It is the basis of the research process and all experimental work.

According to Whitney, "To define a problem means to put a fence around it, to separate it by careful distinctions from like questions found in related situations of need".

It is very important that the problem definition is exact and to the point. A well-defined research process gives direction to the research investigation and suggests the manner in which it has to be conducted. It also allows the researcher to make optimum utilisation of available resources for the purpose of these studies.

The researcher can channelise his activities in a more cohesive and organised manner. Some research activities like understanding the reading habits of a population can be clearly defined, but others like trying to understand the cause for declining sales will require the researcher to opt for an exploratory research.

Problem definition or **problem statement** is a clear, precise and to-the-point statement regarding the problem which the researcher is trying to answer. It can cover the following aspects:

1) Existing business problems where a manager requires a solution or facing a business problem.
2) There are areas where there is scope for improvements.
3) There are situations where greater conceptual clarity is required by the researcher.

Kerlinger has identified three criteria of good problem statements.

1) The problem should be concerned with the variables and their interrelations.
2) It should be stated clearly.
3) It should be testable empirically.

1.4.4.1. Need of Problem Definition

It is often seen that a loosely defined research problem creates lots of problems in effective decision-making. It also obscures the objective of conducting a valid and meaningful research activity. The proper definition of a research not only helps in conducting the research, but also helps in understanding the actual problem which is faced by the researcher. The definition of a research problem should cover the following aspects:

1) Defining the research problem provides a direction to the study.
2) It helps in deciding the methodology and techniques that the researcher has to employ to complete the research activity.
3) The proper research problem definition develops the research objective and helps control the biases of the r rcher.
4) It helps in identifying the variables, which needs to be considered for investigation.
5) A proper definition of research problem helps in making the research activity practical.
6) It brings about better orientation between the various stakeholders.
7) Research problem definition helps to link it with other challenges.
8) It indicates the sources of data that need to be utilised.
9) It prioritises the action that needs to be taken.
10) It helps in the process of decision-making.
11) It helps in identifying relevant data.
12) It points out the gaps in the knowledge base.

1.4.4.2. Steps in Problem Definition

Defining a problem involves the tasks of laying down boundaries within which a researcher shall study the problem with a pre-determined objective in view.

Defining a research problem properly and clearly is crucial part of a research study and must in no case be accomplished hurriedly. However, in practice this is frequently overlooked which causes a lot of problems later on. Hence, the research problem should be defined in a systematic manner, giving due weightage to all relating points. The technique for the purpose involves the undertaking of the following steps generally one after the other:

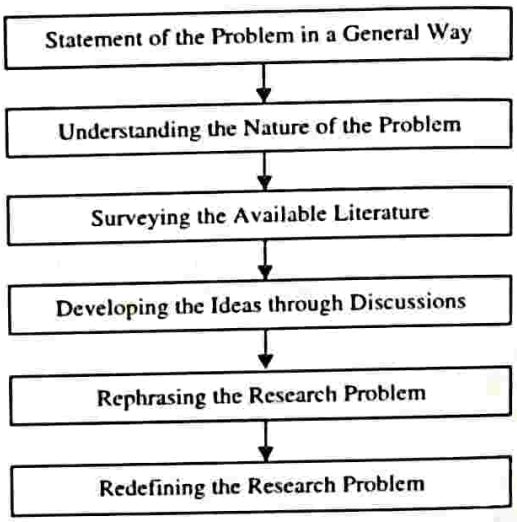

Statement of the Problem in a General Way
Understanding the Nature of the Problem
Surveying the Available Literature
Developing the Ideas through Discussions
Rephrasing the Research Problem
Redefining the Research Problem

Figure 1.3: Steps in Problem Definition

1) **Statement of the Problem in a General Way:** The research problem must address either a specific practical operational issue or some scientific discovery. It can also be pertaining to satisfaction or broadening of a particular intellectual curiosity. Whatever the area of research, the problem definition should generally be at a logical level.
2) **Understanding the Nature of the Problem:** The next step in defining the problem is to understand its origin and nature clearly. The researcher must understand the origin and nature of the problem in clear terms through discussions and study of the environment within which problem is to be solved. The best way of understanding the problem is to discuss it with those who first raised it in order to find out how the problem originally came about and with what objectives in view.
3) **Surveying the Available Literature:** It is important to review and serve all the possible literature that is available on the research area prior to defining the research problem. It assists a researcher to look into newer dimensions in that particular area and leads to enhancement of knowledge. All available literature concerning the problem at hand must necessarily be surveyed and examined before a definition of the research problem is given.
4) **Developing the Ideas through Discussions:** Persons who have knowledge or have rich experience in the area of research have proved to be good sounding board for a researcher. Their advice and comment on research proposal help a researcher to have better clarity and focus on his research topic. Discussion

concerning a problem often produces useful information. Various new ideas can be developed through such an exercise. Hence, a researcher must discuss his problem with his colleagues and others who have enough experience in the same area or in working on similar problems.

5) **Rephrasing the Research Problem:** Finally, the researcher must sit to rephrase the research problem into a working proposition. Once the nature of the problem has been clearly understood, the environment (within which the problem has got to be studied) has been defined, discussions over the problem have taken place and the available literature has been surveyed and examined, rephrasing the problem into analytical or operational terms is not a difficult task. Through re-phrasing, the researcher puts the research problem in as specific terms as possible so that it may become operationally viable and may help in the development of working hypotheses.

6) **Redefining the Research Problem:** Many a times, a problem redefinition happens once the steps listed above are undertaken. Researcher often redefines the problem in a manner which is more viable and logical for the conduct of the research. This effort also helps in defining hypothesis more sharply.

1.4.4.3. Guidelines for Problem Definition

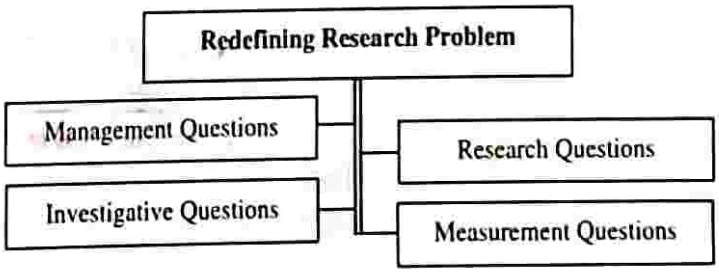
Underlying guidelines should be followed while defining research problem:

1) Overdone subjects should be avoided.
2) A research problem which is controversial in nature should be avoided.
3) Narrow or vague research problem should not be selected.
4) The solutions for research problems should remain within the reach of researcher.
5) Subject, time, and efficiency of researchers is also a very important factor to be considered while defining research problem.
6) A preliminary study should precede the research problem.
7) The research topics that need to be summarised instead of analysed should be avoided.
8) The research topic should interest the researcher.
9) In case, the topic requires in-depth research, then the researcher should be supported by necessary materials and equipment to conduct it.
10) The researcher should be flexible, if the chosen topic proves to be inadequate and useless.
11) The problem statement of research should be precise and complete.
12) The assumptions made prior to conducting the research must be recognised in connection with the research study.
13) The research problem should be practical in terms of application.
14) The problem statement should be logical and based on rational analysis.

1.4.5. Redefining Research Problem

Redefining research problem means to outline the research problem by using various innovative methods of discussions including literature review, brainstorming, etc. When a researcher redefines the research problem, he realises that related problems and issues (which are similar to some extent) have already been focused by another researchers and there is nothing 'new' in the problem. Therefore, for recognising all such related research work, reviewing literature is significant. By performing literature review, a researcher can also direct the research study towards right direction by controlling it through theoretical and conceptual contexts.

There are several questions or problems that need to be resolved at various managerial levels, when a research is conducted in an organisation. The researcher must consider the following questions or problems while redefining the research problem:



1.4.5.1. Management Questions

As management questions transform management dilemmas in question formats, thus it can be said that management questions are derived from management dilemmas. **For example,** declining of sales in a firm can be the management dilemma and the following can be the management questions:

1) What steps should be taken to increase footfall in the retail outlet?
2) Why employees are losing their morale?
3) What are the reasons behind declining profits?
4) What measures should be taken to increase customer satisfaction?
5) What steps can be taken to improve sales?
6) What are the possible factors that will contribute towards greater sales?

Such management questions are of general nature, which are usually tapered towards specific sub-objectives. Like, in the above question "What steps can be taken to improve sales?" can be further divided into two questions:

1) How to improve sales in order to increase profits?
2) How to enhance efficiencies in order to decrease costs?

1.4.5.2. Research Questions

When a researcher clearly understands the management questions, he translates them into research questions. Most of the solutions and alternatives to the research problem are identified through management questions. However, it is not necessary that every solution or alternative is related with the considered research problem. Hence, a researcher systematically evaluates such answers for choosing the most appropriate one. For this purpose, the researcher should have the basic understanding of management, so that the chosen answer can be utilised for further analysis.

Research questions are derived from management questions and are more focused and specific towards research study. The research question for management question "How to increase efficiency by decreasing costs" can be the following:

1) How can the cost of firm's infrastructure reduced?
2) Without affecting the output, how can the employee cost be decreased?
3) Without affecting the functions of retail outlet, how can the logistic cost be decreased?

1.4.5.3. Investigative Questions

Investigative questions are the next level of hierarchy of questions. These questions are comparatively more specific than research questions and are responsible for revealing specific useful data required for answering the research questions. However, investigative questions should be reasonably answered in order to reach at specific conclusions. Investigative questions are considered as the building blocks of hypothesis development and are derived from research questions. For a research question "Without affecting the output, how can the employee cost be decreased?", the investigative questions can be:

1) Which is the best compensation policy that can be implemented?
2) Without paying overtime/bonus, etc., how will the output of the employees improve?
3) In order to improve the overall efficiency level, how to have appropriate balance of permanent and temporary employees?

1.4.5.4. Measurement Questions

Measurement questions are the questions that enable a researcher to gather specific data, essential for conducting the research. These questions are considered as the building blocks of questionnaires. At least one measurement question is asked from every investigative question. The research question "Without affecting the output, how can the employee cost be decreased?" can be divided into following measurement questions:

1) How can we measure employees' efficiency?
2) How can we measure employees' output?
3) How can we measure overall productivity?

Figure 1.4 illustrates the hierarchy of questions:

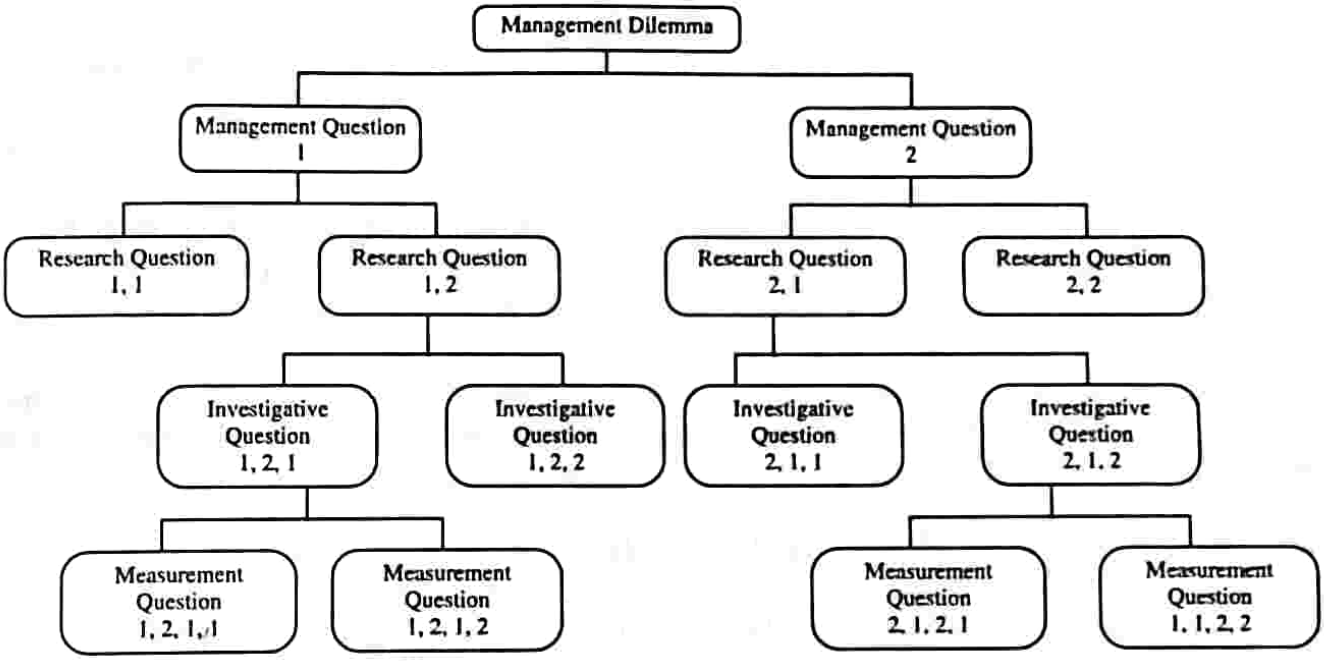

Management Dilemma
Management Question 1
Management Question 2
Research Question 1, 1
Research Question 1, 2
Research Question 2, 1
Research Question 2, 2
Investigative Question 1, 2, 1
Investigative Question 1, 2, 2
Investigative Question 2, 1, 1
Investigative Question 2, 1, 2
Measurement Question 1, 2, 1, 1
Measurement Question 1, 2, 1, 2
Measurement Question 2, 1, 2, 1
Measurement Question 1, 1, 2, 2

Figure 1.4: Questions' Hierarchy

1.5. RESEARCH OBJECTIVES

1.5.1. Introduction

Research objectives defined in clear terms help the researchers to proceed in certain direction. It prevents the researchers from further distractions and enables them an issue to focus on.

Research objectives construct the foundation for the research work. It is an essential ingredient of a research, as the entire effort and resources are applied to accomplish the research objectives. It helps the researchers to provide answers for the specific research questions. Thus, determining research objectives is the critical part of the research process as it supports the completion of the whole research. While defining research objectives the researchers should always remember that these should be comprehensive as well as attainable.

The objectives of the research are helpful in clarifying the type and level of information required for completing the research. This information requirement is further described by the nature of the research as well as by design used in the research. These objectives are the focal point of the any research as answering questions related to these objectives, would result in the completion of the procedure.

1.5.2. Types of Research Objectives

The effort and time that has to be put in the research is dependent on the nature of the information required from that research. Conducting a market research has the following objectives:

1) **Market Attractiveness Evaluation:** This involves evaluation of:
   i) Market sizing – calculating the total market size, part of market covered by the business, targeting realistic market share goals.
   ii) Evaluating the competition and the preference of the customers.
   iii) Customers' pattern of expenditure, their intent and budget cycles.
   iv) Evaluating the trends, commitments and duties of the distribution channels.
2) **Customer Insight:** This includes insight on particular needs of the customers, their desires, preferences, usage and purchase patterns, decision-making, etc.
3) **Competitive Forces:** Here, analysing the current and future status of competition in the market is focused upon.
4) **Communications Planning:** This objective incorporates the medium of communicating with the customers and different ways to reaching them. The objective here is to find out the most effective means of communicating with the customers.

5) **Product Testing:** Product testing in business research includes evaluation of different aspects of the product like its packaging, substitutes, improvements etc.
6) **Concept Testing:** Business research also tries to test the concept of new products (and solutions) in the market. It also helps in analysing the fulfilment of wants and needs of the customers.
7) **Advert Testing:** It aims at analysing the product substitutes, their commitments, convincing power, ability to make an impact, intent *versus* out take, call to action, etc.
8) **Customer Satisfaction:** Research also aims to measure the factors leading to customer satisfaction. These factors include quality of customer experience, their intentions, reactions, loyalty, perceptions, etc.
9) **Pricing:** This objective of business research evaluates the price of the product alongwith its quality, features, positioning and packaging, loyalty and promotional schemes, etc.
10) **List Building:** This includes compiling information and making a list of the prospects for the purpose of establishing direct contact with them. This might be considered unethical due to which some researchers do not practice it.

1.5.3. Components of Research Objective

Following factors should be determined for effective research objectives:

1) **Research Question:** Research question focuses on certain aspects of the research which provide useful information for conducting research. These aspects together define the research objective. **For example,** what government policies can be designed for improved employment? In this question every aspect is clear and specific which cannot be present in broad objective.
2) **Research Hypotheses:** Research hypotheses are the assumptions made and tested to analyse the variables and interrelations among them. These statements are more focused than the research objectives. These hypotheses help the researchers to answer the research questions by examining empirically. Hence, research objectives should be stated in a way that can allow the researchers to formulate hypotheses clearly.
3) **Boundary of the Study:** The next important factor which should be finalised before determining objectives is to decide boundary of the study. In best case, researchers should consider the entire target population, as the boundary. But, this can prove to be infeasible and unmanageable. Hence, a proper definition and selection of boundary is very essential for defining the objective clearly.

1.5.4. Guidelines for Statement of Research Objectives

Certain guidelines should be considered while formulating the objectives of research. These guidelines are as follows:

1) **Precise:** The language of the research should be kept clear and precise so that it is easily understood by the marketing manager. Also it should clearly depict the items of research.
2) **Specific:** The objective of the research has to be specific and properly defined. This makes it easier to define the research problem which further enables the researcher to find appropriate solution to the problem. Method of collection of the required information associated with the problem of research is provided by certain objectives.
3) **Measurable:** The objectives of the research must be measurable. This is because it helps the research to stay on track in achieving the desired goal which further improves the quality of the research design.
4) **Achievable:** The research objectives should be achieved within the stipulated time period. The research should also make best use of the resources and deliver correct results within the given time. Objectives which are achievable make sure that every step of research is completed within time which further helps in the achievement of goals.
5) **Realistic:** Realistic objectives should be set in order to make effective utilisation of resources (men, machines and money). The objectives which clearly define the research problem tend to be useful. Such objectives ensure steps to be taken within a given time as a result of which realistic objectives are more naturally attainable.
6) **Timely:** Timeliness ensures that the objectives are achieved within the specified time frame. The research problem takes sufficient time to resolve a business problem. The timeline specifies the time within which the objectives are to be achieved.
7) **Detailed:** The research project should be detailed enough so that it elaborates every item with the help of examples.

1.6. RESEARCH HYPOTHESES

1.6.1. Introduction

It is derived from a Greek word "hypotithenai" which means "to put under" or "to suppose". Hypothesis is the process of taking and using a sample statistics to make an inference for a population parameter.

According to Prof. Morris Hamburg, "A hypothesis in statistics is simply a quantitative Statement about a population".

According to Palmer O Johnson, "A hypothesis is islands in the uncharted seas of thought to be used as bases for consolidation and recuperation as we advance into the unknown".

Hypothesis generally occurs when we perform inductive reasoning. In inductive reasoning, researcher takes a series of observations to perform a theory. So hypothesis is the first step of any research process. It is very important for any research and formulated in various ways. Its basic function is the prediction of the final result of the investigation.

1.6.2. Characteristics of a Good Hypothesis

A good hypothesis has following characteristics:

1) **Clear and Precise:** Hypothesis should be clear and precise. If the hypothesis is not clear and precise, the inferences drawn on its basis cannot be taken as reliable.
2) **Ability to Test:** Hypothesis should be capable of being tested.
3) **State Relationship between Variables:** Hypothesis state relationship between variables, if it happens to be a relational hypothesis.
4) **Limited in Scope:** Hypothesis should be limited in scope and must be specific. A researcher must remember that narrower hypotheses are generally more testable and researcher should develop such hypotheses.
5) **Simple:** Hypothesis should be stated as far as possible in most simple terms so that the same is easily understandable by all concerned. But one must remember that simplicity of hypothesis has nothing to do with its significance.
6) **Consistent:** Hypothesis should be consistent with most known facts i.e., it must be consistent with a substantial body of established facts. In other words, it should be one which judges accept as being the most likely.
7) **Logical:** If there is two or more hypothesis derived from the same basic theory they should not contradict each other.
8) **Amenable:** Hypothesis should be amenable to testing within a reasonable time. One should not use even an excellent hypothesis, if the same cannot be tested in reasonable time for one cannot spend a life-time collecting data to test it.
9) **Subjectivity:** Researchers subjectivity or his biased judgment should be eliminated from the hypothesis.

1.6.3. Types of Hypothesis

Hypotheses are of following types:

1) **Research Hypotheses:** The research hypothesis is a directional hypothesis, i.e., it indicates the expected direction of the results. The direction is implied by theory or previous research. The hypothesis would not indicate the expected direction of the results in exploratory studies where there is no strong rationale for an expected direction. When it is time to test whether the data support or refute the research hypothesis, it needs to be translated into a statistical hypothesis.
2) **Statistical Hypothesis:** It is given in statistical terms. Technically, in the context of inferential statistics, it is a statement about one or more parameters that are measures of the populations under study. Statistical hypotheses often are given in quantitative terms, e.g., "The mean reading achievement of the population of third grade students taught by Method A equals the mean reading achievement of the population taught by Method B".

The two hypotheses in a statistical test are normally referred to as:

i) **Null Hypothesis:** A statistical hypothesis which is stated for the purpose of possible acceptance is called null hypothesis. It is usually denoted by the symbol H_0. **For example,** the null hypothesis may be expressed symbolically as:

$H_0 : \mu = 162$ cms.

According to Prof R.A. Fisher: "Null hypothesis is the hypothesis-which is tested for possible rejection under the assumption that it is true."

The following may be borne in mind in setting the null hypothesis:

a) If we want to test the significance of the difference between a statistic and the parameter or between two sample statistics then we set up a null hypothesis that's difference is not significant. This means that the difference is just due to fluctuations of sampling:

$H_0 : \mu = \overline{X}$

b) If we want to test any statement about the population we set up the null hypothesis that it is true. **For example,** it we want to find it the population mean has specified value μ_0, then we setup the null hypothesis.

$H_0 : \mu = \mu_0$

ii) **Alternative Hypothesis:** Any hypothesis which is complementary to the null hypothesis is called an alternative hypothesis and is usually denoted by H_1 or H_a. **For example,** if we want to test the null hypothesis that the average height of the soldiers is 162 cms., i.e.,

$H_1 : \mu = 162$ cms. $= \mu_0$ (say)

Then the alternative hypothesis could be:

a) $H_1 : \mu \neq \mu_0$ (i.e., $\mu > \mu_0$ or $\mu < \mu_0$) b) $H_1 : \mu > \mu_0$ c) $H_1 : \mu < \mu_0$

1.6.4. Significance of Hypothesis

Significance of hypothesis can be described in following ways:

1) **Finding Answers:** Hypothesis supports the researcher to find an answer to a problem. It is expressed in declarative form. The most important thing is that it provides a guideline to the problem.

2) **States Purpose of Researcher:** A hypothesis states what researchers are looking for. When facts are assembled, ordered, and seen in a relationship they constitute a theory. The theory is not speculation but is built upon fact. Now the various facts in a theory may be logically analysed and relationships other than those stated in the theory can be deduced. At this point there is no knowledge as to whether such deductions are correct. The formulation of the deduction however constitutes a hypothesis; if verified it becomes part of a future theoretical construction.

3) **Forward Looking:** A hypothesis looks forward. It is a proposition which can be put to a test to determine its validity. It may seem contrary to or in accord with common sense. It may prove to be correct or incorrect. In any event however, it leads to an empirical test.

4) **States Specific Relationship:** Hypothesis is to state a specific relationship between phenomena in such a way that this relationship can be empirically tested. The basic method of this demonstration is to design the research so that logic will require the acceptance or rejection of the hypothesis on the basis of resulting data.

5) **Provides Direction:** It provides a direction to the research and prevents waste of time and effort of the researcher.

6) **Helps in looking in Particular Aspect:** It helps the researcher to look into a particular aspect of the problem thereby offering certain issues and facts.

7) **Framework for Analysis:** It acts as a framework for analysis and interpretation of the data to draw conclusions.

8) **Suggests Areas of Importance:** It suggests the areas of importance which need more attention or more collection of facts by the researcher.

9) **Ensures Scientific Nature of Research:** A hypothesis ensures the entire research process remains scientific and reliable; and following the principles of deduction.

1.6.5. Limitations of Hypothesis

Limitations of hypothesis are as follows:

1) **Fashion of Testing:** The tests should not be used in a mechanical fashion. It should be kept in view that testing is not decision-making itself; the tests are only useful aids for decision-making. Hence "proper interpretation of statistical evidence is important to intelligent decisions".

2) **Explanation of Difference:** Tests do not explain the reasons as to why does the difference-exist, say between the means of the two samples. They simply indicate whether the difference is due to fluctuations of sampling or because of other reasons but the tests do not tell us as to which is/are the other reason(s) causing the difference.

3) **Lack of Certainty:** Results of significance tests are based on probabilities and as such cannot be expressed with full certainty. When a test shows that a difference is statistically significant, then it simply suggests that the difference is probably not due to chance.

4) **Lack of Accuracy:** Statistical inferences based on the significance tests cannot be said to be entirely correct evidences concerning the truth of the hypotheses. This is specially so in case of small samples where the probability of drawing inaccurate inferences happens to be generally higher. For greater reliability, the size of samples is sufficiently enlarged.

1.7. THEORY AND RESEARCH

1.7.1. Introduction

A theory is a set of interconnected and systematically arranged concepts, definitions and propositions that have been propounded to explain a particular event or phenomena. Therefore, many theories have been formulated in order to explain the happenings in the surrounding.

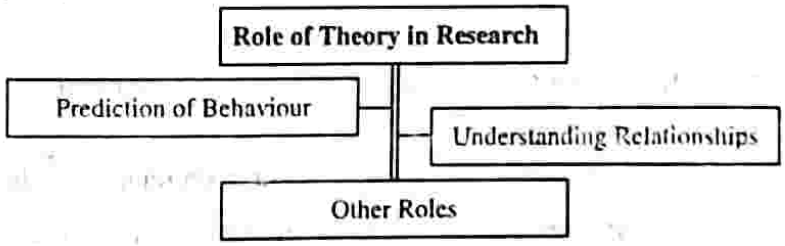
One can successfully explain or predict the happenings, when the theories are sound and are suitable for the situation. It is the responsibility of researchers to formulate broader and comprehensive theories that will explain the effect of changes in different variables on the surroundings. "Theoretical framework" is synonymously used with the terms "theory", "theoretical model" and "theoretical system". Theoretical frameworks strive to find a set of core constituents within a topic and try to show how they can all be associated together in synergy.

A theoretical framework acts as a roadmap or plan that provides knowledge about a certain matter which is relevant for the research. It explains the methods and guidelines that help the researchers in conducting research effectively and in obtaining the results accurately.

It is very important for the researcher to understand and analyse the theory around which the basics of particular research revolve. By answering some basic questions, the researchers can develop an informal theory regarding the research.

1.7.2. Role of Theory in Research

The scientific knowledge in the field of research can be developed with the help of theory in research. This takes place in the following ways:



1) **Prediction of Behaviour:** The behaviour of a certain event or occurrence can be estimated by the knowledge gained from another event with the help of research theory. By studying and verifying the behaviour of one event or occurrence, a researcher can predict the behaviour of another such event.

For example, if one theory proposes that older investors are more inclined towards the investment income than the young ones, then upon verification of this theory, it will enable the researchers to predict the significance of expected yield in the dividend based on the age of the investors. The prediction of future circumstances in an organisation or the environment is critical; however, solely prediction might not be able to fulfil the objectives of the scientific research. Gaining understanding and knowledge is also desired by the researcher. **For example**, one can predict the result of an election but the reason behind the victory of a candidate cannot be determined. Also, understanding and prediction go simultaneously in almost all situations. The reason behind the specific behaviour of variables is important to understand in order for prediction. Such understanding is provided by the theories.

2) **Understanding Relationships:** Theories also help in gaining insights about the relationship among different variables. They are regarded as a set of assumptions which are considered as principles in describing the relationship that exists among certain events.

3) **Other Roles:** Other roles played by theory in research are as follows:
   i) Research helps in suggesting a problem to be studied.
   ii) Formulates a hypothesis that needs to be tested.
   iii) Explains the relationship among variables and the event.
   iv) Makes the findings of the research understandable.
   v) Restricts the scope of the study by offering a conceptual model.
   vi) Assists in selecting the variables or identifying classes of data to be gathered.
   vii) Offers a mechanism to verify, revise and encourage additional research in the fields that require investigation.
   viii) The concepts that are suitable to the problem of the research are stated by the theory. It also offers their definitions, measurements and relationship with one another.
   ix) Assists in maintaining consistency with previously established body of knowledge and relationships.

1.7.3. Importance of Theory in Research

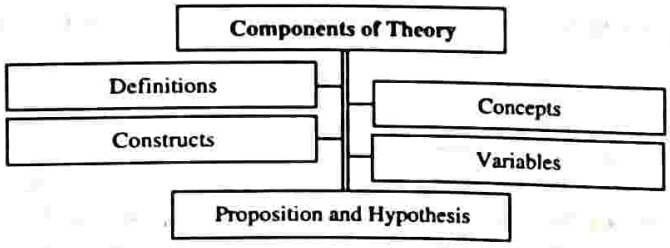
Theories are important in any research due to the following reasons:

1) Clear statements of the theoretical assumptions allow the researchers to be examined minutely.
2) Theories link the researchers with the existing pool of knowledge. This allows them to frame a hypothesis and choose the appropriate research methodology.
3) By following the assumptions as required by the theory, the researcher is forced to ask himself 'why' and 'how' regarding the research. It does not only allow the researcher to describe a phenomenon, but it also allows the researcher to generalise various other aspects concerned with the phenomenon.
4) The theory also allows the researcher to identify the various constraints in his generalisations. The theory also identifies which variable is the main variable of interest. It draws the attention of the researcher to these key variables.

The theoretical framework focuses on the main variables that are of interest. Thus, it allows the researcher to focus on the key variables. He collects data and analyses and interprets the data pertaining to the key variables. This helps him to gather knowledge on these variables by validating or questioning the assumptions that are given in the theory.

1.7.4. Components of Theory

Theory has following components:



1) **Definitions:** Confusion in the application of the constructs can severely affect the utility of a research report. It can severely damage the research report without the researcher even getting to know about it. If the words have different meanings for different stakeholders, then it is obvious that the communication process has not been proper. One way of reducing this problem is to define the various words being used so that they have the same meaning to all the people who use the report. It is therefore essential that the researcher knows the meaning of various constructs being used in the research report.

   Researchers face difficulty regarding two types of definitions, i.e., dictionary definitions and operational definitions. In the typical **dictionary** setting a concept is tagged with a synonym. **For example**, a customer is defined as 'patron'; a patron in turn is described as 'a customer or client of the business and so on'. These types of circular definitions normally serve in everyday settings but are not adequate for a research setting. In research, constructs and concepts are measured and require far more rigorous definitions.

   Operational Definitions

   Operational definitions are the statements that define a particular term considering certain criteria in order to test or measure. The terms must be such that they are amenable to empirical standards. In other words, the standards should be possible to count, measure or gather information through the senses of human being. A concept may be physical (a chair or a table) or may be abstract (motivation). In either case, the definition should specify the characteristics and the norms for measurement of the same. The specifications and standards should be clear so that the person who is using will know how they are to be applied.

2) **Concepts:** Concepts are the basic building blocks in the activity of research. They can be thought of as a collection of meanings or characteristics that are linked with something else. They can be linked with objects, conditions, events, situations and behaviours. When these linkages are categorised in accordance with some common traits, then they give rise to concepts. **For example**, printed word is an example of a large category from which many concepts, such as, books, magazines, newspapers, websites, etc., can be created.

   Concepts form the first stage of any research activity and in general, they have a very broad application. They also serve as bases for theories and help in the process of communication, classifying and the building of thoughts and ideas. In a research activity, the concept is first taken from a theoretical stage to an observational stage. This process is called "conceptualisation". There are several ways in which this process of conceptualisation can be done. Many a times, the research cannot properly explain the way in which the process of conceptualisation took place. However, it is the task of a researcher to explain the process through which conceptualisation became abstract to concrete.

   In the research process, it is very necessary that the concepts generated be measured. Concepts can also be qualitative, but they are converted into variables through a process known as "operationalisation". Thus, a theory is a statement that strives to make sense of reality. Reality comprises of events that the researcher can identify, classify and observe. **For example**, in psychology, the mental state of a person is observed. Therefore, the disturbance in mental state is a reality. However, the question that arises here is, "what can be those circumstances that may lead to mental disturbance of a person?". Therefore, psychology can be a field, which consists of multiple theories, which explains learning, perception, motivation, etc., of human beings.

   Sources of Concept

   Various sources of concept are as follows:

   i) **Personal Experience:** It is very easy for experienced researchers and scientists to create concepts as their nature of work exposes them to new observations and events. By naming these new observations, they create concepts.

   ii) **Continued Observation:** Continued observation is another way of creating concepts. By continued observation, new perspectives are gained regarding an existing behaviour which gives rise to new concepts.

   iii) **Borrowing from Other Languages:** Concepts can also be borrowed from other languages. English as a language has borrowed various concepts from other languages like Latin, Greek, etc.

3) **Constructs:** There are advanced levels of concepts, which imply the extent upto which it has the objectivity. **For example**, a graph is an objective concept, as it can be visualised and its characteristics are known. However, the personality of a human being cannot be visualised nor imagined, which makes it an abstract concept. Such abstract concepts are called "constructs". A construct is nothing but an image or an

abstract idea which has been designed specifically for the purpose of a research study. Constructs are created by combining simpler concepts. Generally, people confuse between a concept and construction. The difference lies in the degree of abstraction associated with the two. A construct is more abstract in nature than a concept.

A construct can be a theoretical aspect, which can be measured by one or more variables. The terms 'concept' and 'construct' are often used interchangeably. However, authors often distinguish between the two. A concept is regarded as more general. All constructs are concepts but all concepts are not constructs. 'Pain' is both a construct and a concept. However, 'ideal mother' is a concept and not a construct.

Types of Constructs

Constructs can be of two types:

i) **Intervening Variables:** Intervening variables are used as a summary term for a group of constructs. Independently, these variables have no meaning, except the context in which it has been used. **Clark Hull**, a behaviourist who propounded the hypothetical-deductive mode of learning, made extensive use of intervening variables while building his learning theory. Hull defined the term reaction potential as a combination of three variables – habit, strength and drive. Reaction potential is an intervening variable as it summarises three other constructs namely habit, strength and drive. In isolation it has no meaning. Hostility is another example of an intervening variable as it summarises two constructs namely hostile and aggressive acts.

ii) **Hypothetical Construct:** A hypothetical construct is the type of construct, which is used to describe something and is real. It is therefore an intermediary, which has tangible characteristics. Habit, strength, etc., are examples of hypothetical constructs. Another example of hypothetical construct is the word 'reflex', which can be observed. The term "knee jerk' refers to the involuntary movement of the knee when a small force is applied at a particular point on the knee. The term 'reflex' refers to the sequence of events that occur after a stimulus is given to an object or organism. The term reflex is therefore a hypothetical construct.

4) **Variables:** The term variable is often synonymous with the construct that is being measured. A variable is a symbol, act, trait or attribute, which can be measured and can be given categorical values. While doing data entry and analysis, numerical values are assigned to variables. **For example**, some variables are dichotomous and can take only two values. An example of this is the typical yes/no variable or the male/female variable or the employed/unemployed variable. These variables either have a property or do not have it. Variables can also take on more parameters example religion and other demographic variables. These variables are all examples of discrete variables as only certain values can be assigned.

Difference between Concept, Construct and Variables

Basis of Difference	Concepts	Constructs	Variables
1) Meaning	Involve organising and identifying abstract thoughts.	These are visualisations of less abstract real concepts.	Variables are the concepts that can be assigned any value.
2) Nature	Concepts are logical in nature.	They are hypothetical in nature.	They are direct and easy to measure.
3) Objective	They deal with the human ability to categorise the ideas and thoughts.	Constructs are formulated for a specific purpose in research.	Variables are used in research to see the effect of changes in one variable on the other.
4) Example	"Punishment" is quite concrete. It is directly observable.	"Racism" is a construct, which consists of many activities such as casteism, religious discrimination, etc.	"Height" can be considered as a variable it is different for different people.

5) **Proposition and Hypothesis:** A **proposition** is a statement about observable events which can be found to be either true or false. When a proposition is specifically formulated for testing and analysis in experiments, it is called a **"hypothesis"**. The conjuctional and tentative statement related with the relationship between two or more variables. A hypothesis can be thought of as being a formal statement which explains some outcome or happening. At a very basic level a hypothesis can be an assumption. **For example**, a marketing manager may frame a hypothesis that the salespeople who have the best knowledge about market, will be the best in the providing marketing support. A hypothesis can be empirically tested. The hypothesis should be written in such a manner that after being empirically tested it is either accepted or rejected.

1.8. EXERCISE

1.8.1. Short Answer Type Questions

1) What do you understand by the term research?
2) Highlight the significance of research in business.
3) State limitations of research.
4) What do you mean by pure research?
5) Is exploratory research is beneficial?
6) When can causal research be used?
7) What are the drawbacks of empirical research?
8) Define the types of research, on the basis of time dimension.
9) Write a short note on time series research.
10) How to formulate research objectives?
11) State the components of research problems.
12) Differentiate between hypothesis and proposition.
13) Explain null hypotheses.

1.8.2. Long Answer Type Questions

1) Define research. Enumerate its nature and objectives.
2) Illustrate the evolutionary perspective of research.
3) Explain the details of a research process.
4) What do you mean by business research? What are objectives of a general business research?
5) Elucidate the scope and managerial value of business research.
6) What are the factors that affect business research? Discuss.
7) Explain applied research and descriptive research.
8) What do you mean by research problem? How the problem is identified? Give the process of problem definition.
9) What are the different types of research objectives? State the guidelines for statement of research objectives.
10) Illustrate the characteristics of a good hypothesis. How many types of hypothesis can be framed?
11) Does theory plays any role in research? What are the different components of theory?
12) Write short notes on:
    i) Cross-sectional research
    ii) Longitudinal research

UNIT 2

Understanding Research Design and Measurement

2.1. RESEARCH DESIGN

2.1.1. Meaning and Definition of Research Design

When a research is carried-out, it follows a definite pattern or plan of action throughout the procedure, i.e., since the problem identification to the report preparation and presentation. This definite pattern or plan of action is called "research design". It is a map that guides the researcher in collecting and analysing the data. In other words, research design acts as a blueprint that is followed throughout the research work. **For example**, a building cannot be constructed without the knowledge of its structure. A builder cannot order raw materials or set dates till he knows the structure of this building, such as office building, school, home, etc.

According to William Zikmund, "Research design is defined as a master plan specifying the methods and procedures for collection and analysing the needed information".

According to Green and Tull, "A research design is the specification of methods and procedures for acquiring the information needed. It is the over-all operational pattern or framework of the project that stipulates what information is to be collected from which sources by what procedures".

According to Selltiz *et al.*, "A research design is the arrangement of conditions for collection and analysis of data in a manner that aims to combine relevance to the research purpose with economy in procedure".

A research design is not only a work plan, it also specifies the type of data required to address the research problem. It ensures that the data analysis and the conclusions lead to answering the initial questions of researcher in a simple way. Therefore, a research design provides the structure of a research in such a way that it provides relevant outcomes economically.

2.1.2. Features of a Good Research Design

It is considered that a good research design should reduce the biasness while should maximise the reliability of data being collected and analysed. A good research design should provide the opportunity as per the various aspects of research problem. It should minimise the experimental error and should provide maximum information. Hence, it can be concluded the selection of research design relies upon the research problem and the nature of research. Following are the major features of a good research design:

1) **Objectivity:** Objectivity refers to the ability of the research instruments to give conclusions that are free from observer's personal biases. A good research design should be able to select those instruments only that provide objective conclusions. Usually, it is believed that maintaining objectivity is pretty easy, but it proves to be difficult during execution of research and data analysis.

2) **Reliability:** Another essential feature of a good research design is the reliability of responses. The instruments used in research should be able to provide similar responses to a question asked from a respondent. If the response varies, the instrument is considered unreliable. In other words, reliability of research design is measured in terms of consistency in responses.

3) **Validity:** An important characteristic of a good research design is its ability to answer the questions in the way it was intended to. It should focus on the objective of the research and make specific arrangements or plan for achieving that objective. **For example**, when a research is conducted to measure the effects of advertisements in viewers, it should be able to answer this, and not the sale of a particular product.

4) **Generalisability:** A research design is said to be generalisable if the outcome of the research is applicable on a bigger population from which the sample is selected. A research design can be made generalisable by properly defining the population properly, selecting the sample carefully, analysing the statistical data appropriately, and by preparing it methodologically. Therefore, the more the outcomes are generalisable, more efficient is the research design.

5) **Sufficient Information:** Any research is conducted to gain insight of the hidden facts, figures and information. The research design should be able to provide sufficient information to the researcher so that he can analyse the research problem in a broad perspective. The research design should be able to identify the research problem and research objective.

6) **Other Features:** Alongwith the above, there are some other features also that make a research design good. These are adaptability, flexibility, efficiency, etc. A good research design should be able to minimise the errors and maximise the accuracy.

2.1.3. Factors Affecting Research Design

Various factors that affect research design are as follows:

1) **Research Questions:** Research questions perform an important role in selecting the method to carry-out research. There are various forms of research designs which include their own methods for collecting data. **For example,** a survey can be conducted for the respondents to ask them descriptive or interconnected questions while a case study or a field survey can be used to identify the firm's decision-making process.

2) **Time and Budget Limits:** Researchers are bound with restricted amount of time and budget to complete the research study. The researcher can select experimental or descriptive research when the time and budget constraints are favourable to him for the detailed study, otherwise exploratory research design can be adopted when the time is limited.

3) **Research Objective:** Every research is carried-out to obtain the results which help to achieve some objectives. This research objective influences the selection of research design. Researcher should adopt the research design which is suitable for research objective and also provides best solution to the problem alongwith the valuable result.

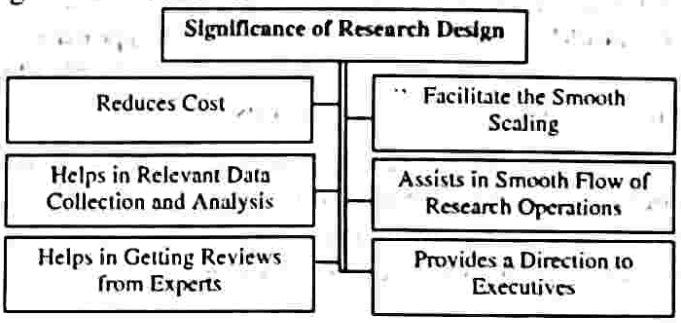
4) **Research Problem:** Selection of the research design is greatly affected by the type of research problems. **For example,** the researcher selects experimental research design to find out cause-and-effect relationship of the research problem. Similarly, if the research problem includes in-depth study, then the researcher generally adopts experimental research design method.

5) **Personal Experiences:** Selection of research design also depends upon the personal experience of researchers. **For example,** the researcher who has expertise in statistical analysis would be liable to select the quantitative research designs. While, those researchers who are specialists in theoretical facets of research will be forced to select qualitative research design.

6) **Target Audience:** The type of target audience plays very important role in selection of research design. Researcher must consider the target audience for which the research is carried-out. Audiences may either be general public, business professionals or government. **For example,** if the research is proposed for general public, then the researcher should select qualitative research design. Similarly, quantitative research design would be appropriate for the researcher to introduce the report in front of the business experts.

2.1.4. Significance of Research Design

Significance of research designs are as follows:


Significance of Research Design
Reduces Cost
Helps in Relevant Data Collection and Analysis
Helps in Getting Reviews from Experts
Facilitate the Smooth Scaling
Assists in Smooth Flow of Research Operations
Provides a Direction to Executives

1) **Reduces Cost:** Research design is needed to reduce the excessive costs in terms of time, money and effort by planning the research work in advance.
2) **Facilitate the Smooth Scaling:** In order to perform the process of scaling smoothly, an efficient research design is of utmost importance. It makes the research process effective enough to give maximum relevant outcome in an easy way.
3) **Helps in Relevant Data Collection and Analysis:** Research design helps the researchers in planning the methods of data collection and analysis as per the objective of research. It is also responsible for the reliable research work as it is the foundation for entire research. Lack of proper attention in preparation of research design can harm the entire research work.
4) **Assists in Smooth Flow of Research Operations:** Research design is necessary to give better and effective structure to the research. Since all the decisions are made in advance, therefore, research design facilitates the smooth flow of research operations and reduces the possible problems of researchers.
5) **Helps in Getting Reviews from Experts:** Research design helps in developing an overview about the whole research process and thus assists in getting responses and reviews from different experts in that field.
6) **Provides a Direction to Executives:** Research design directs the researcher as well as the executives involved in the research for giving their relevant assistance.

2.1.5. Research Design Process

The stages in the process of research design are interactive in nature and often occur at the same time. Designing of research study follows given process:

Step 1: Defining Research Problem: The definition of research problem is the foremost and important part of a research design process. Defining the research problem includes supplying the information that is required by the management. Without defining the research problem appropriately, it is not possible for the researcher to conclude the accurate results. While defining research problem, the researchers first analyse the problems or opportunities in management, then they analyse the situation. The purpose of clarifying the research problem is to make sure that the area of concern for research is properly reflected and management decision is correctly described. After situation analysis, they develop a model for research which helps in the next step which is specification of information.

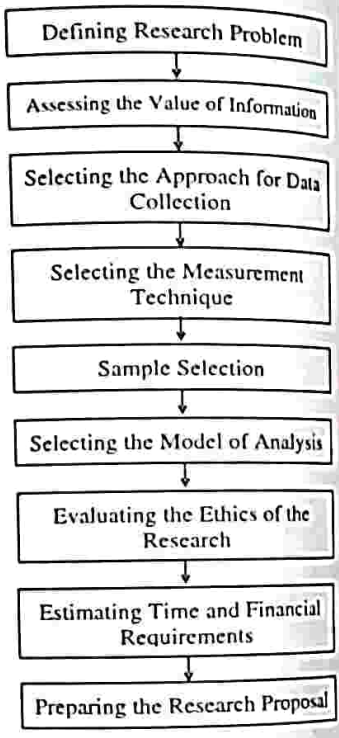

Defining Research Problem
Assessing the Value of Information
Selecting the Approach for Data Collection
Selecting the Measurement Technique
Sample Selection
Selecting the Model of Analysis
Evaluating the Ethics of the Research
Estimating Time and Financial Requirements
Preparing the Research Proposal

Figure 2.1: Research Design Process

Step 2: Assessing the Value of Information: When a research problem is approached, it is usually based on some information. These data are obtained from past experiences as well as other sources. On the basis of this information, some preliminary judgements are made regarding the research problem. There is always a need for additional information which is available without additional cost and delay but waiting and paying for the valuable information is quite difficult. **For example**, a car manufacturing industry may be concerned about decrease in the sale of a particular model. A researcher will look for the solutions by analysing various aspects. For this, the researcher has to continuously collect a lot of information and needs to evaluate them by understanding their value and filtering out useless information.

Step 3: Selecting the Approach for Data Collection: For any type of research, a researcher needs data. Once it is identified that which kind of information is required for conducting the research, the researchers proceed towards collecting the data. The data can be collected using secondary or primary sources. Secondary data is the previously collected information for some other purpose, while the primary data is collected by the researcher especially for the research problem.

Step 4: Selecting the Measurement Technique: After collecting data, the measurement technique for the collected data is selected. The major measurement techniques used in research are as follows:

1) **Questionnaire:** Questionnaire is a formal structure which contains questions to collect the information from the respondents regarding his attitude, beliefs, behaviour, knowledge, etc.

2) **Attitude Scales:** Attitude scales are used to extract the beliefs and feelings of the respondents regarding an object or issue.

3) **Observation:** It is the monitoring of behaviours and psychological changes of the respondents. It is widely used in research.

4) **Projective Techniques and Depth Interview:** Sometimes direct questions are not sufficient to get true responses from the individuals, that is why, different approaches like depth interviews and projective techniques are used. These techniques allow the respondents to give their responses without any fear. Researcher neither disagrees nor gives advice in these techniques.

Step 5: Sample Selection: Once, the measurement technique has been selected, the next step is selecting the sample to conduct the research. The researchers in this stage select a sample out of the total population instead of considering the population as a whole.

Sample can be selected by using two techniques, i.e., random sampling techniques, and non-random sampling techniques.

Step 6: Selecting Model of Analysis: Researchers select the model of analysis or technique of data analysis, before collecting data. After this, researchers evaluate the techniques using hypothetical values to ensure that the measurement technique would provide the desired outcome regarding the research problem.

Step 7: Evaluating the Ethics of Research: While conducting research, it becomes very much necessary for the researcher to follow ethical practices. The researches which are conducted ethically draws interests of general public, respondents, clients and other research professionals.

Hence, it becomes the duty of the researcher to evaluate the practices in research, to avoid any biasness on behalf of the observer and researcher as well.

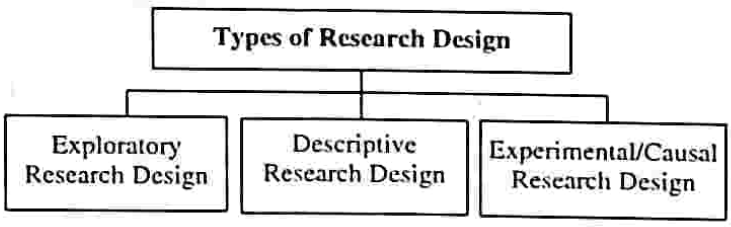
Step 8: Estimating Time and Financial Requirements: This step is one of the most important steps in designing research. Here, researchers use different methods like Critical Path Method (CPM) and Programme Evaluation Review Technique (PERT) to design the plan as well as control process and to determine the resources required.

A flowchart of these activities alongwith their approximate time is prepared for visual assessment of the research process. With the help of this chart, the researcher can find out the sequence of activities to be taken.

Step 9: Preparing the Research Proposal: The final step in the process of research design is preparing the research proposal. A research proposal or the research design is prepared for the operation and control of research. An effective research proposal is prepared before actual conduction of the research.

2.1.6. Types of Research Design

Based on the aim of study, there are three types of research design:



1) **Exploratory Research Design:** Exploratory research design aims to get a better understanding of the problem by explaining the concepts and developing hypotheses regarding the research study. Various techniques used in exploratory research study are literature survey, surveys, focus groups, case studies, etc. Exploratory research does not emphasise upon sampling, but tries to gather information from participants who are considered knowledgeable.

2) **Descriptive Research Design:** Unlike exploratory research, the aim of descriptive research is to describe the characteristics of a phenomenon. It is more rigid than exploratory research. It describes various aspects

related to a population. It is the study that is designed to depict the population in much more accurate way. It attempts to describe, explain and interpret the conditions in much detailed approach. It examines a phenomenon that is occurring at a specific place and at specific time.

3) **Experimental or Causal Research Design:** Experimental or Causal or Conclusive research design is a type of research design which is predetermined and structured in nature. It is used for causal or conclusive research, which is conducted quantitatively. It is called causal research, because it is helpful in exploring the cause and effect relationship of a research problem. The main objective of casual research is to test the hypotheses which were defined in the exploratory Research Design. Causal research is simply opposite to the descriptive research, as with the help of experimentation, it can interpret whether the relationship is causal or not.

2.2. EXPLORATORY RESEARCH DESIGN

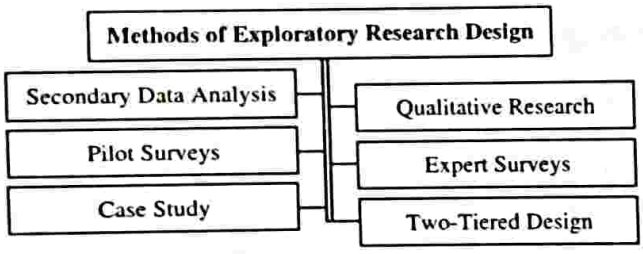
2.2.1. Introduction

Exploratory research design is the research design implied in case of exploratory research. In this type of research, researchers try to uncover the hidden and unknown facts and phenomena. This kind of research is helpful in exploring the information for problems which have not been defined precisely. It is also called as **formulative research**. It tries to answer the questions with appropriate reasons. **For example**, in order to find out the reasons behind the continuous growth of cases of Ebola infection, exploratory research is used as the information providing the reasons is hidden in this case.

Exploratory research design is suitable for those cases, where no prior studies or background knowledge is available for reference. The major focus of these studies is to gain knowledge so that further investigations can be carried-out. Basically, this research is the initial stage of future in-depth investigations. Sometimes, exploratory research is conducted to know the suitable methodology for certain research problem. A general exploratory research design attempts to provide maximum information in minimum time with least possible effort and money. Final decisions or results cannot be prepared with the help of exploratory research. Using this research, the researcher is able to develop the hypotheses regarding various research problems.

2.2.2. Methods of Exploratory Research Design

Exploratory research is carried out using following methods and techniques:



1) **Secondary Data Analysis:** The foremost approach of a researcher for gaining knowledge regarding an issue is to go for existing literature also called secondary data. It includes collecting and evaluating facts and information already available about the selected research problem. It can be done through analysing literature. Generally, journals are useful in providing required information as results or findings of different researches can be found in these journals.

Precisely, it can be said that literature review involves the thorough analysis and examination of prior research. It acts as the summary and provides deep review of the particular or specific research area. Analysing existing literature answers many questions relating to the research problem. Secondary data reveals the gap between researcher's knowledge and available research in that field. The aim here is to be able to understand the facts and knowledge already available about a particular topic along with their merits and demerits. Literature review is not just simply a collection of different synopsises or reading materials, it is a systematic description of prior studies which is written according to a guiding model.

2) **Qualitative Research:** To conduct an exploratory research more accurately, researchers need to conduct qualitative research. Qualitative research is a technique in which main focus is on collecting reliable data from its natural environment, rather than the numbers, figures, or statistical techniques. Thus, issues which cannot be analysed quantitatively can be analysed and interpreted through qualitative research.

The unique feature of qualitative research is the collection of data which includes multiple sources instead of a single source. Here, the particular research topic is understood from view point of the target population. This kind of research includes small samples and is exploratory and unstructured in nature and includes small samples.

Major techniques of qualitative research are as follows:

i) **Depth Interviews or Experience Survey:** One of the ways for conducting qualitative research is depth interview or experience survey. This interview is conducted involving a small number of participants to understand their views and perspectives on certain issue or situation. **For example**, a researcher may ask respondents about the current law and order situation in a particular city, their experiences and suggestions may also be asked.

Depth interviews are conducted for various reasons such as estimating needs, developing and enhancing planning process, problem identification, etc. Unlike surveys, in depth interviews, researchers ask open-ended questions to few respondents that allow the participants to respond in detail.

ii) **Focus Groups:** Focus group is a qualitative technique that consists of an unstructured group of 6 to 10 participants, and an interviewer called moderator. This interview is conducted to get a deep insight about a relevant research problem by allowing the participants to express their feelings. The moderator directs the discussion towards the research topic. Hence, this way the moderator is also a direct participant of the conversation. Sometimes, researchers get such an understanding that is rarely obtained from any other method including less interaction.

Focus groups are considered as a useful source that facilitates reliable, accurate, and unbiased information. The purpose for conducting focus group interviews may include the development of new product or concept of product, improved production, designing motivation curriculum for new employees, or developing new product line. Focus groups provide ideas and information that are used in future experiments. The discussions carried-out using focus groups are used in improving the research questions and hypotheses as well as in comparative analysis of research designs.

iii) **Projective Techniques:** Projective techniques are the loosely structured qualitative techniques where the researchers try to get a better understanding of the research problem. In this technique, the researchers ask indirect questions to the researchers to draw out the emotions, beliefs, feelings or thinking of individuals relating to the concerned topic.

In projective techniques, the respondents interpret the behaviour of others instead of their own attitudes and perceptions. This way, respondents somehow show their own attitude and feelings. Therefore, researchers analyse the behaviour of a participant by giving them some unstructured and unclear situations. The projective technique is based on the work in clinical psychology, which explains that by creating more complex and confusing situation, more individual projection of motives, emotions, attitudes or feelings can be drawn. This technique helps in expressing hidden or unexpressed emotions or thoughts of individuals by allowing them to project the expected reactions or behaviours of other people in a given situation.

3) **Pilot Surveys:** When a survey is conducted on a relatively sample which is randomly drawn from the target population, it is called pilot survey or pilot study. These are of short duration involving a small fraction of individuals, organisations, or places from the larger target population. Therefore, in pilot surveys, the procedures and techniques to be followed are loosely structured and not strict and accurate enough as in quantitative techniques. Pilot study is an economic technique. In this technique, researchers without disclosing their identities, try to understand the feelings and experiences that are felt by the respondents. **For example**, the owner of a chain of restaurants uses pilot survey to investigate the real image of the restaurants in the mind of customers. He/she simply occupies a suitable table in the restaurant and observes the activities of customers.

The data generated by pilot studies are not for quantitative analysis, but for analysing qualitatively. This feature makes the pilot survey different from a research, where relative information is gathered through secondary data. The qualitative data generated through pilot studies come directly from the intended participants rather than from the cases or experts which makes it different from experience surveys and case studies.

4) **Expert Surveys:** Another significant technique of exploratory research is the expert survey or opinion survey. It includes the collection and interpretation of information gathered from experts from concerned area of research. In experience survey, researchers try to acquire the knowledge of experts from inside or outside the organisation. Since, the experts know that survey is dependent on their experience; they are motivated to provide their own ideas and experiences about the research issue or problem.

   Expert surveys are conducted to get the knowledge from the experts of certain field of research, which is rarely accessible. Expert surveys are used to reveal the linking between different significant variables attached to the concerned research issue for getting valuable information. **For example,** in order to find out the buying preferences of customers about four-wheelers, expert survey can be used. The dealers or retailers are preferred to be the key persons giving the required information through their experience and knowledge. They can provide better information as they better understand the need and desire of customers.

5) **Case Study:** This is among the most popular methods of qualitative research analysis. In this method, a thorough analysis of a unit is performed. This unit can include a diverse range of entities such as an individual, a family, a cultural or regional group, an institution, a community, etc. This study emphasises on in-depth analysis of a limited issue rather than broad analysis of many issues. Case study tries to analyse the relevant incidents, processes, or situations and their interdependence. The main objective of this technique is finding the factors which may describe the behavioural outline of the given entity in an integrated form.

   In case study technique, the researchers investigate the situations that are similar to the research objective. The prime objective of analysing a case study is to gain knowledge about similar situations so that research can be conducted more objectively. The in-depth or detailed knowledge about the concerned entity or organisation with thorough attention on detailed information is the main benefit of this kind of technique. This in-depth analysis allows the researchers to trace the events as per their occurrence. **For example,** a car manufacturing company facing declining sales, may analyse the case of its competitor to understand the steps taken by them car manufacturer when their sale decreased.

6) **Two-Tiered Design:** Two-tiered design is another exploratory research technique that is carried-out in two steps. In the first step, the research problem is clearly defined, and in the second step, the research design on the basis of research problem is designed. This technique is suitable when the research problem has not been previously defined or has been defined ambiguously. Hence, this technique helps the researcher in clearly understanding the objective.

   While the first stage of two-tiered design includes qualitative data, the second stage requires quantitative data. With the help of this technique, researchers are able to formulate a more structured design for a comparatively unstructured research study. Sometimes, researchers intentionally omit the first stage, and directly begin with the second stage, since the first stage requires significant time, money, and effort. But, they should not skip the first stage, as it helps in defining the objectives more clearly that leads to more definite structure.

2.2.3. Application of Exploratory Research Design

Following are the applications of exploratory research:

1) **Investigating an Issue:** Exploratory research is generally used to investigate a particular issue. It helps in drawing out the insight and related information about the concerned topic or issue. A particular research problem is selected for exploratory research to find its solution. **For example,** identifying the reasons behind child labour in a particular demographic area may be the topic of exploratory research. Thus, it may help in highlighting the factors responsible for child labour.

2) **Gaining Information:** Information about a particular event or issue can be easily collected through exploratory research without incurring large amount of money or effort. **For example,** pilot studies can be used for collecting information about developing a questionnaire.

3) **Establishing Priorities:** Priorities can be easily established through exploratory research, when it is involved in observing several competing issues or objects. **For example,** priorities for organisational products or services can be developed through customer complaint letters.

4) **Clarifying Concepts:** Different typical concepts may also be clarified through exploratory research. **For example,** management of an organisation aims to enhance dealer satisfaction through modifying its service policies; an exploratory research can be conducted to explain the term dealer satisfaction. In another example, customers of a particular bank, i.e., retail and commercial customers, can be clarified through exploratory research.

5) **Framing Problems:** Exploratory research is also used to frame different typical problems. **For example,** through collecting information about the level of water in certain areas, a water crisis problem can be framed by exploratory research. Different techniques like observations, personal interviews, focus groups, etc., may be used for this purpose.

6) **Knowing Market Trends:** Exploratory research is also useful in knowing the trends prevalent in the target market so as to help management decide its strategy. Sometimes, management is not able to design a suitable strategy for the market due to unavailability of required information. Exploratory research may be very useful in this situation. **For example,** different crucial information about the market can be collected through exploratory research in order to develop product modifications.

2.2.4. Significance of Exploratory Research Design

Exploratory research is useful in following ways:

1) **New Discoveries:** Exploratory research helps a researcher to find-out new ideas and insights regarding a situation. It always tries to explore the unfamiliar aspects which were previously unknown. Researchers always welcome new ideas and information because it helps them to mould research in new direction which ultimately gives better results and conclusions.

2) **Enhances Knowledge:** Exploratory research is very helpful in adding knowledge to the ongoing research. New knowledge to the existing pool of knowledge enhances the understanding of researchers related to certain area of research. Since, exploratory research is not backed by statistical methods, the conclusions about a given research problem cannot be developed. However, a clear outline of the subject is effectively produced through this research.

3) **Wide Range of Techniques:** Exploratory research facilitates the researchers to select the techniques from a wide range of available sources. The sources used in exploratory research may be published secondary sources as well as some other sources like depth interviews, case studies, expert surveys, case studies or casual discussions. The researchers can carry-out the research process with the help of one or more of techniques from this broad spectrum to better understand the issue.

4) **Directs Future Research:** Exploratory research provides valuable conclusions and new insights about the research topic. These findings and insights trigger the researchers for further researches and acts as a platform for successive investigations. Exploratory research helps the researchers to understand an issue in a better way that helps in deciding the approach to be taken to achieve the desired outcomes.

5) **Strategic Planning:** Exploratory research is also beneficial for strategic planning in organisations as the conclusions of this research provide general outline of the given subject, which helps in formulating strategies for future. **For example,** in new product development process, an exploratory research may be conducted which can provide the expected need and demand of such products in the market. If, the conclusions are not so favourable, new product planning process may be altered or terminated.

2.2.5. Limitations of Exploratory Research Design

Besides many advantages, exploratory research has following limitations:

1) **Leads to Wrong Decisions:** Since, exploratory research does not include statistical analysis to find the conclusions; hence the conclusions of these researches can be completely reliable. Due to this drawback, relying on these findings may lead to wrong decisions. Exploratory research is qualitative in nature, and therefore the outcomes are quite judgemental.

2) **Incorrect Information:** Since, the outcomes of exploratory research are qualitative, therefore the analysis may subject to some personal biases. In addition to this, the results are not distinctive, but are generally vague. Because of this limitation, it requires further research to confirm the findings.

3) **Cannot be Generalised:** The results of the exploratory research cannot be generalised for the whole population as these only explore the understanding of a given situation or problem. It cannot be used for representing the responses or thinking of the entire population.

4) **Costly:** Conducting exploratory research requires significant amount of time and money to arrive at conclusions. Even after spending resources, researchers cannot be certain about the conclusions.

2.3. DESCRIPTIVE RESEARCH DESIGN

2.3.1. Introduction

When the objective of the research is to describe the characteristics of a phenomenon or population, the researchers select descriptive research. It can provide and describe the critical features and information about the target population or environment. It describes the answers for questions like what, who, how, when, where, etc. The objective of descriptive research is to reveal the already present data or feature in the given population. In other words, it can be said that descriptive research seeks to explain a phenomenon and the reasons and assumptions behind the specific behaviour. **For example**, archaeologists explained the Harappan civilisation and described many significant findings such as urban planning, baked brick houses, drainage system, water supply system, etc., which has influenced modern society to a great extent.

Descriptive research emphasises on explaining the phenomenon by providing factual and accurate information, but does not discuss the variables responsible for a situation. Also the effect of a particular variable cannot be measured, it can only be described. Therefore, it cannot be used for describing the cause and effect relationship among the variables.

Descriptive research focuses on the status of a given environment. It is very suitable for research in education, management, epidemiology, and social sciences, behavioural sciences, etc. Both qualitative and quantitative data are produced through descriptive research that helps in describing the state of nature at a given time.

2.3.2. Methods of Descriptive Research Design

Major methods or techniques for conducting descriptive research are as follows:

1) **Evaluating Secondary Data:** Sometimes, to collect the primary data, it is essential to collect and analyse the secondary data first. These secondary data are already available in form of magazines, journals, previous researches, which saves the time from conducting a survey. Even if the primary data is already collected, most of the projects analyse quantitative secondary data for various purposes.

   The factors which make secondary data less trustworthy are validity and reliability of those data. If the data are collected and analysed keeping in mind the reliability and validity, analysis of quantitative data becomes more effective. An example of quantitative secondary data is census data, crime rates, unemployment rates, etc.

2) **Survey:** Survey is a systematic descriptive technique that is conducted to collect the information from a sample of individuals drawn from a large population. Generally, surveys are carried-out with the help of well-constructed questionnaire. In this method, the researchers ask questions to the respondents to which they answer, and their answers are subsequently recorded. After the completion of questionnaire, these data are analysed and interpreted to get the conclusion. For effective and reliable survey, a questionnaire should be simple and well-constructed. The questions used in the questionnaire should be properly sequenced and easy to understand.

   The technique of survey is widely applicable to many areas that include primary data collection. Survey can be conducted in many forms such as feedback forms, mail surveys, face to face in-depth interviews, etc.

3) **Panels:** Panels are mostly used progressively for syndicated research projects. In this method a panel of study units such as organisations, households, retail stores, etc., from which data is collected periodically. This kind of measurement provides data that show the changes in behaviour, attitudes, perceptions, etc., over time.

Various commercial institutions sponsor the panel studies and are maintained by different research agencies. Panels can be studied for numerous purposes such as to analyse the trends in market, assess the changes in market due to changes in marketing mix variables. Although panel studies are suitable for these researchers, considerable efforts should be made to control the dynamic variables. **For example**, in a consumer panel, buying behaviour of individuals is observed with respect to time.

4) **Observation:** One of the most common methods used by researchers to collect data is to observe the situation or phenomenon. Here, it is important to note that observation does not only mean to see things, but to intensively monitor and understand them deeply to interpret about them.

   Researchers select observation for data collection because with the help of observation various unspoken expressions can be recorded along with their timings. It also reduces the possibility of personal biasness that occurs during other methods. It allows the researchers to record detailed descriptions and formulate relevant questions to bring out the nature, intention, attitude, etc. An example of observation study can be used to estimate the percentage of population who obey the traffic rules.

5) **Case Study Method:** Another technique used for descriptive research is case study. In this, a similar incident or situation (sometimes a small number) is comprehensively analysed so as to gain the information about the real problem. While in survey method, few amount of information is gathered about a large population, in contrast, in case study method, a large amount of information is collected about one or few respondents. By examining one significant case, the researcher is able to draw thorough conclusions about several other related cases.

   Although, case study cannot be used for making inferences or generalisations about a particular population, the conclusions drawn from the case studies play a significant role in developing concepts and theories by providing sufficient reasoning. Case study is generally used to deal with the critical issues faced by organisations in their operations. The prime purpose of analysing a case is to enhance the pool of knowledge in various fields. In this technique, usually the researchers study the case histories of organisations, institutions, programmes, etc., rather than an individual. Several fields like psychology, medicine, sociology, management and counselling etc., use case study for information gathering.

6) **Longitudinal Research:** Longitudinal research attempts to examine the features of people or units at more than different points in time. It is used in examine the changes in society. Longitudinal research is used in descriptive and explanatory researches. It is comparatively costly and complex than cross-sectional research. Longitudinal research is of three types:

   i) **Time-Series Research:** Time series research aims at collecting data from a population at regular interval which can be in weeks, months, years, etc., on same variable in terms of aggregate measures. The researcher compares the changes over time by taking the measurements in different time periods. These researches can be used for measuring the changes over time, trends in market, and forecasting the short-term future as well. The data in time-series research are represented using charts and graphs. Examples of time series research can be the measurement of employment, poverty, crime over the certain period of time.

   ii) **Cohort Study:** In cohort study, a group of respondents who experience the same events during a same time interval are observed. Rather than measuring the same people, it seeks to observe different categories of people. The group of respondents should belong to the same group who experience the same. This research is "explicitly macro-analytical" in nature, which implies that the researcher considers the whole category for observing the features. An example of cohort study is measuring the changes in voter opinions during polls.

7) **Cross-Sectional Research:** Cross sectional research is a snapshot of a phenomenon that represents the data at one point in time. It shows how those variables would be pointed out in a section of a population. This kind of research uses survey method for data collection. Although it is most suitable with the exploratory research but it can also be used along descriptive and explanatory researches as well. It is very cost-efficient and simple in nature.

8) **Other Methods:** Besides above methods, some other methods are as follows:

   i) **One-Shot Survey Design:** One-shot survey design is the basic type non-experimental research. It this technique, researcher carries out a single observation to describe the phenomenon or situation. It is preliminary research type, but holds a good position in descriptive research.

ii) **Trend Survey:** Trend survey seeks to estimate perceptions regarding a group's shared experience. The distinctive characteristic of trend surveys is that it measures the perceptions of a group rather than individual's perception. Trend surveys consider many groups and measure the changes in their perceptions to trace any trend. Trend surveys are conducted on general public to represent common interest. These studies can be carried-out for short as well as long duration projects. Since, in long duration projects many factors are subjected to change making the outcomes invalid and vague, researchers prefer to carry-out trend surveys for short-term projects. An example of trend survey can be, surveying the hiring policy of an IT company and measuring the perceptions of hiring committee over time to trace a trend.

iii) **Follow-Up Survey:** Follow-up surveys require an additional step past panel surveys. In a follow-up survey, researchers survey a group of individuals then again survey the same group several years later, then surveys the same group a third time several years after the panel group study has completed.

iv) **Developmental Survey:** In this type of descriptive research, the development in learning and performance of people are measured with time. This research is carried out with the help of longitudinal research, in which group of people are measured over time.

Since, it becomes difficult to trace same group over a long period of time, hence to overcome this problem cross sectional method can be adopted, where people from different age groups are selected to assess the effects of maturity. A good example of developmental survey is to measure the attitude of viewers of cinema, where the perceptions can be measured by selecting people from different age group.

2.3.3. Application of Descriptive Research Design

Descriptive research can be applied in following areas:

1) **Highlighting Social Problems:** Descriptive research highlights the prevalent social problems in a region. It helps in designing related policies as well as social actions so as to combat such problems. **For example**, different social problems like poverty, drug addiction, hunger, child abuse/ child labour, public education, environment pollution, crime, medical issues, etc., are described with the help of descriptive research only.

2) **Real Life Situations:** Descriptive research is also used in exploring real life situations or issues. It helps in identifying problems, taking decisions or formulating theories about what other people do in the similar situation.

3) **Identification of Relationship:** It is also used in identifying relevant relationships between different factors. **For example**, relation between a disease and risk factors can easily be described by descriptive research. A relation may be described between the data collected and the situational variables of the study or between data collected and the behavioural variables of the participants. **For example**, training program of a given retail institution or the qualities of successful salespersons can be easily explored by the descriptive research design.

4) **Acquiring Knowledge:** In case a particular situation or topic is not researched earlier or very small amount of information is available on a particular issue, descriptive research is used to acquire knowledge about such events. It generates need for or acts as a basis for further research on such topics in the future.

5) **Observing Natural Behaviours:** In order to observe natural behaviours of respondents, descriptive research is used by researchers. Different social scientists, psychologists, anthropologists, etc., use descriptive study to collect natural behaviour of the target object. **For example**, organisations aiming to analyse the morale of the staff or the marketers wishing to identify the buying habits of customers, use descriptive research design.

2.3.4. Significance of Descriptive Research Design

Significance of descriptive research can be understood by following heads:

1) **Wider Scope:** Descriptive research has wider scope as it tries to describe the characteristics of population. The tools and techniques of descriptive research are applied in many areas such as opinion polling, media or advertising research, educational research, market research, etc.

2) **Provides Life Experiences:** The speciality of a descriptive research is that, it does not only rely upon qualitative data, but also on quantitative data. Both these types of data have their own relative benefits. Such large amount of data provides enormous insight to the life experiences.

For example, observational technique helps the researchers to get various life experiences and facilitates knowledge about other's point of view

3) **Provides Relevant Data:** Due to the combination of both the qualitative and quantitative aspects, the data collected through this research is relevant and comprehensive. The researcher is able to collect data from all possible sources like panels, observations, case analysis, etc. With the help of descriptive research techniques, the researcher can have in-depth information about the research problem through both the theoretical and numerical approaches.

4) **Reduces Risk:** Descriptive research identifies the distinctive features or characteristics that allow the researchers to identify the risk factors or errors which can be highlighted and eliminated to produce the accurate outcome.

2.3.5. Limitations of Descriptive Research Design

Descriptive research has following limitations:

1) **Unwillingness to Answer:** The major limitation of descriptive research is the unwillingness of participants to answer. The respondents selected for data collection may not provide true information. These respondents may manipulate their responses to match with the researcher's need. Similarly, the respondents may also refuse to answer the personal or little complicated questions.

2) **Manipulation of Responses:** Observer's paradox is another limitation of the descriptive research. The respondents do not reflect their natural behaviour in the case they know that they are being observed. The observer is able to record only the altered behaviour of the respondents, which affect the accuracy of the result.

3) **Errors:** Errors may be there in the result of descriptive researches. For all the descriptive researches, the questions are pre-designed and fixed according to the nature of the research. There is always a possibility of error in the process of study. The researcher decides which information is to be utilised and which to be discarded, according to the hypothesis formed. The whole process is based on the experience of the researcher, and hence, outcomes may be erroneous.

4) **Requires More Skills:** For effective completion of the descriptive research, more skilled executives and researchers are needed.

5) **Unreliable and Unscientific:** Descriptive research may be unreliable and unscientific due to the absence of analytical methods. The results of descriptive techniques cannot be reproduced for reviewing the research findings.

2.3.6. Types of Descriptive Research Design

In order to derive answers to the questions like who, what, when, where, and how, researchers take the help of descriptive research. It helps in determining who the buyers are, what products they buy, the time or situation when they buy, the place where they buy, and how they buy. Descriptive research is also used to explore findings of a given research project.

Descriptive research is of two types:

1) Longitudinal Studies/Analysis
2) Cross-Sectional Studies/ Analysis

2.4. EXPERIMENTAL/CAUSAL RESEARCH DESIGN

2.4.1. Introduction

In order to establish a cause and effect relationship, the primary principle is to prove that in an experiment first the cause happens and then the effect follows it. Four kinds of relationships may occur between cause and effects, they are as follows:

1) Either the cause can occur or it can be made to occur and its effect can follow immediately,
2) Either the cause can occur or it can be made to occur but its effect cannot follow immediately,
3) The cause cannot occur but it can be made to occur, however, its effect can follow immediately,
4) The cause cannot occur as well as it also cannot be made to occur and its effect cannot follow immediately.

The absolute motive of a research is to establish a cause and effect relationship. This is the reason why experiments are conducted in such a way that only those causes are considered which can establish a logical relationship with the effects consistently. Experimental research design or "design of experiments" or "causal research design" studies causality, i.e., cause-and-effect relationships between Research variables. In this type of research design, researcher selects two similar groups from the target population, one is called 'experimental group' and the other is 'control group'. While control group is kept constant and free from any interference, experimental group is exposed to set of experiments. At the end of experiment, the changes in experimental group are measured by comparing it from control group. Therefore, the factors affecting the change are identified.

Experimental researches are controlled and structured in nature. To understand the causal relationship, it is necessary to manipulate one or more independent variables to measure the effects on dependent variables. Therefore, experimental or causal researches help in collecting experimental knowledge or information, which is based on experimental data rather than theories. This research may be helpful in understanding an event or enhance the performance in a particular field. Experimental research is important to society as well for business, as it helps in predicting the future activities. It provides an outline of activities to be performed to test the relationship between various variables by proving hypotheses. In other words, it is a structured design that allows the researchers to carry-out experiments.

2.4.2. Criteria for Causality in Experimental Research Design

There are three basic conditions that are required for a relationship to be causal. Although these conditions alone are not sufficient to prove a cause-and-effect relationship, but these are necessary. Following three conditions must be satisfied for the causality in experimental research design:

1) **Concomitant Variation:** Concomitant variation is the degree to which the causing factor (X) and effective variable (Y) show the relation as predicted by the hypothesis. The evidence of relationship can be measured in qualitative or quantitative manner. **For example**, in qualitative case, to estimate the relationship between the performances of team members (effect) and their salary (cause) can be estimated by formulating a hypothesis supporting the concomitant relation. Therefore, this concomitant relation would show that increasing salary increases the performances of team members, while reducing salary decreases their performances.

2) **Time Order of Occurrence of Variables:** According to this criterion, the causing event cannot happen after the effect has been taken place. It must occur before or concurrently with the effect. An effect cannot be generated by the event that occurs after the occurrence of effect. Though, it is possible for an event to act both as cause and an event in same relationship. **For example**, team members who get higher salary (cause) perform better (effect), while the employees who perform better (cause) can get higher salary (effect).

3) **Elimination of other Possible Causal Factors:** The last condition for the causality in the experimental research is the elimination of other possible causal factors. As per this criterion, there should be only one causing factor keeping other factors constant. **For example**, the salary of the team members can be the only possible causing factor, when all the other variables such as working environment, employee involvement, recognition, promotion, etc. are kept constant while estimating the relationship. While on one hand, in an after-the-fact examination, controlling all the variables is not possible, on the other hand, controlling some of the causing variables is possible up to some extent. The effects of several uncontrolled factors may be stabilised for determining only the random variations from them.

2.4.3. Causal Relationships

In case of explanatory social research, when two or more variables establish a causal relationship among them, then it justifies the topic on which research is being conducted. **John Stuart Mill** referred a cause as a notion of constant conjunction. In other words, any event or entity can be a cause of any other event or entity only if both the events are taking place at the same time; provided that, the cause should take place before the effect and other probable causes should be ignored to keep the relationship authentic. Various quantitative researchers have used causality as a separate domain of research by using experimental methods, non-experimental methods, or structural equation modelling alongwith the non-experimental data.

Types of Causal Relationships

The types of causal relationships are as follows:

1) **Direct Causal Relationship:** When an entity or event is believed to be a direct cause of occurrence of any other event or entity, then that relationship is known as direct causal relationship. **For example**, inclination of an adolescent child toward drugs depends on his relationship with his parents, i.e., poor relationship is believed to be a cause of drug addiction.

2) **Indirect Causal Relationship:** When a variable impacts another variable, which in turn impacts one more variable, then the relationship between the first and the third variable can be referred to as indirect causal relationship or the mediated relationship. In such cases the second variable is known as intermediary variable, mediating variable, or mediator. **For example**, a person who fails to achieve his pre-determined goal may get frustrated. Due to this frustration, he may behave aggressively with any other person. Hence, in the stated example, the failure of achieving the goal shares an indirect causal relationship with the aggressive behaviour of the person. And the frustration aroused due to the failure is the intermediary variable. It is very likely that according to one theory a relationship is direct and according to another the same relationship is indirect.

3) **Spurious Relationship:** The relationship, in which the two variables are related not because of the occurrence of each other but because of the occurrence of a common cause, is known as spurious relationship. **For example**, a research is conducted in order to identify the relation between feet size and the verbal ability of human beings, and it is found that bigger the feet a person has, more is his verbal ability. This is certainly not an example of a causal relationship instead they are correlated because both of them have a common cause, i.e., both of these variables are dependent on the age factor. Infants have small feet and they cannot speak clearly, as they grow young they learn to speak a little bit, and as they grow old they become more efficient in verbal communication. The verbal ability and the feet size are correlated to each other because of a common cause; hence the relationship among them is said to be spurious.

4) **Moderated Causal Relationship:** Similar to indirect causal and spurious relationship, moderated causal relationship also involves minimum of three variables. In this kind of relationship two variables share a causal relationship but it depends on the value of third variable involved in it. **For example**, certain treatment gives relief to the stomach ache, but only for male patients and not for female patients. Hence, the causal relationship among that treatment and the relief in stomach ache depends upon the gender of the patient. Gender, in this case, can be termed as the moderator variable as the relationship between two variables entirely depends on it.

5) **Bidirectional or Reciprocal Causal Relationship:** In case of bidirectional relationships, both the variables are related to each other on the basis of certain reasons. **For example**, in order to prevent the pregnancy a method is used named as rhythm method. Here, the bidirectional relationship can be seen among the belief of women regarding the effectiveness of method and their attitude towards the method. Some women believe that this method is effective; therefore they may develop a positive attitude towards the method. In the same way, some other women have a positive attitude towards the method; therefore they may think that the method is effective.

6) **Unanalysed Relationship:** Unanalysed relationship is that relationship where the two variables are correlated with each other but the reason behind their correlation is neither evident nor the researchers and theorists want to state them.

2.4.4. Basic Principles of Experimental Design

Experimental designs follow three basic principles, which are as follows:

1) **Randomisation:** Treatments are assigned to the experimental units with the help of the process of randomisation. This process denotes that the possibility of assigning all the treatments is equal. The experiment material is divided into several small units, which are known as experimental units and the conditions of experiment whose effect is to be measured are known as treatments. Randomisation is done with the intent to remove the element of biasness and the possibilities of unnecessary and uncontrollable variations. Randomisation alongwith the replication is also beneficial because it serves as a basis on which a valid statistical test can be conducted. Well-shuffled pack of cards, well-shaken box containing balls, dice, etc., can be used for the process of randomisation.

2) **Replication:** The literal meaning of replication is repetition, i.e., in this process the basic experiment is repeated. Basically, during replication all the treatments are tested in the actual experiment. Due to the fact that all the experimental units cannot be identical, slight variation can be seen in every experiment. In order to get rid of such variations, various experimental units should be used. Hence, researchers prefer to conduct the experiment several times. One repetition is referred to as replicate and experimental material derives the number of replicates, their shape, and their size. Purposes behind using replication are as follows:
   i) Accurate estimation of experimental errors by recording the variation so that this variation can be compared with the other variations when same treatment is applied again on the same experimental units.
   ii) Reduction of experimental errors in order to increase the accuracy or precision of experiments. Precision is tool for measuring the variations of the experimental errors.
   iii) Estimating the mean effect of the treatment more accurately because $\sigma_y^2 = \frac{\sigma^2}{n}$, where 'n' stands for the number of replications.

3) **Local Control:** When randomisation as well as replication fail to remove all the unnecessary variations, then arises the need of improvement in the technique of experiment, i.e., the researcher needs to re-design the experiment, keeping in mind that the unnecessary variations are to be kept under control. In order to help the researchers in the stated problem, the principle of local control can be used. Local control refers to certain extent of balancing, blocking, and grouping of the experimental units.

   'Balancing' means allotment of treatments to an experimental design in order to keep the arrangement of treatments balanced. 'Blocking' refers to the process of collecting all the units together in order to form a group of comparatively similar units. The block so formed is also known as replicate. One of the prime objectives of local control is to reduce the errors in experiments so that the efficiency of experimental designs can be improved. It is very important to understand that the local control is not similar to the term 'control', because in the field of experimental design control refers to the treatment.

2.4.5. Treatment and Control Group in Experimental Research

The notion of control establishes a fact that two persons, groups, or conditions are not different from each other. The thing that differs among them is their interest. In such cases, the research is said to be valid internally and the method of difference is also applicable. **For example**, two similar groups of persons are selected. First group is tested by giving them certain treatment; hence that group is **treatment or experimental group.** Whereas, no such treatment is given to the second group; hence that group is **control group.** In such experiments, control group is treated as the benchmark and the experiment group is compared with it because initially both the groups were similar. Therefore, the changes due to experiment can be easily seen among the members of experiment group and the credit of these changes can be given to the treatment.

In case of experiments, the experimenter intently introduces certain factor in one group and keeps the other group away from it. Then the experimenter observes both the groups in order to spot any change in one group. If any change occurs, then that change is certainly because of the factor introduced by the experimenter in one group. Some changes take place with time and these changes are equal for everyone. But, if the groups are similar to each other, same changes will also take place in both of them. This is the reason why the researchers use experiments and not the time factor, for identifying the changes. Because, with the help of experiments it can easily be concluded that the changes occurred to the treatment group are due to the factor induced in that group.

Control groups are formulated either by allocating random experimental units from outside or by the experimental units themselves. In any research, the experimental units are selected out of their population on a random basis and then out of the selected units, they are divided into the experimental groups and the control groups. Control groups are also known as contrast groups or baseline groups. In order to arrive at the inference, the outcomes of both the groups are compared and influence of the treatment is evaluated by measuring the differences between the outcomes of control group and different experiment groups. In case of true-experimental studies, the experimental units are selected from their population on a random basis, but their allotment in the experiment and control groups is based on the baseline data or control data. Then this control data is compared with the assumed outcome data, which makes the experimental data their own control group. On the contrary, in the case of quasi-experimental studies, researchers do not assess the effect of treatments on the experimental units.

2.4.6. Types/Methods of Experimental Research Design

According to the **Campbell** and **Stanley**, experimental research design can be described with the help of following symbols:

X = A set of treatments introduced on experimental group.

O = Observations or measurements taken on independent variable. In case of more than one observation, these can be denoted with the help of subscripts, i.e., O_1, O_2... O_n).

R = Random assignment of the test units.

Experimental research designs can be carried out using following methods:

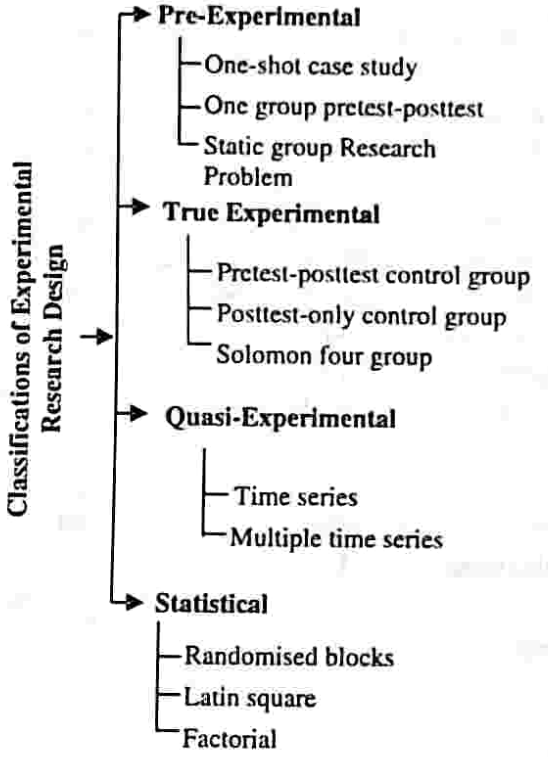


Figure 2.2: Experimental Designs

2.4.6.1. Pre-Experimental Designs

In pre-experimental designs, treatments are not allocated to the subjects randomly. Therefore, these designs cannot be called true-experimental designs, as these techniques do not deal with the challenges which have occurred due to loss of internal validity. These designs are suitable for the cases, when it is the only possible solution for an experiment. Various pre-experimental designs are as follows:

1) **One-Shot Case Study:** This technique is also known as 'after-only design'. In this technique, only one test unit is assigned a treatment X, and then a single measurement O_1 is taken on dependent variable. The test units are not randomly assigned to the treatments, and the test units are selected by the researcher. **For example**, if a primary school teacher wants to see if praising children cause them to become more confident. He tests it with two students of second standard, and praises them. He finds that they are more confident.

Hence he concludes that:

Group	Treatment	Post-test
Experimental Group	**X**	**O_1**
Students	Praise	Confidence

While one-shot case study is the most basic form of experiment, it has its own limitations. It does not allow the researcher to compare the measurement O_1 with the dependent variable before the treatment. Alongwith this, the measurement of one-shot case study can be affected by many extraneous variables, which cannot be controlled. This in turn affects the validity of the measurement. Therefore, this type of research is suitable for exploratory research rather than experimental research. This technique is opted only when it is the only solution to the problem.

2) **One Group Pretest-Posttest:** In one group pretest-posttest design, only one group is involved which is exposed to the treatment. Here, the researcher measures the subjects before and after the implementation of treatment. It is the improvement over one-shot case study, as it allows researchers to compare the changes in objects from before and after stages. **For example,** a sales manager may wish to conduct a training programme to enhance the knowledge of sales team members. The sales manager may measure the knowledge of team members as 'O_1'. As the training programme is completed, the sales manager may again measure the knowledge level of team members as 'O_2'.

Group	Pre-test	Treatment	Post-test
Experimental Group	**O_1**	**X**	**O_2**
Sales Team Members	Selling Skills	Training Programme	Selling Skills

This technique is widely used in marketing research. It also suffers from disadvantages. There is a possibility that other extraneous variables cause the change rather than the treatment.

3) **Static Group:** In this technique, there are two groups upon which measurements are to be taken. The first group is experimental group which is subjected to the treatment, and the other one is control group, which is not subjected to the treatment. Here, the measurement of experimental group is taken after being exposed to treatment, while the control group is measured without treatment. The outcome of the experiment is measured by comparing both the measurements. **For example,** a researcher may wish to compare the effect of a medicine by giving it to a patient, and comparing his condition with another similar patient without the medicine.

Group	Treatment	Post-test
Experimental Group	**X**	**O_1**
Patient	Medicine	Patient after treatment
Control Group		**O_2**
Patient		

Experimental Variable Effect = (O_1-O_2)

Although, this technique is more reliable than previous techniques, but it also has some disadvantages. This technique does not assure that both the control group and the experimental group are equal in every aspect. If the groups are selected randomly, and the group elements are not similar in nature, then the outcome may differ which may affect the validity of findings. When the group elements are selected by the researcher, then it is called as an after-only design with control group.

2.4.6.2. True Experimental Designs

True experimental research design is considered to be the most accurate type of experimental research design. In this type of experimental designs, researchers try to conduct research to prove some hypotheses using statistical techniques. True experimental designs are as follows:

1) **Pretest-Posttest Control Group Design:** In this technique, a measurement is taken both from the experimental and control group before the treatment is administered on control group. After the treatment is subjected, a posttest is conducted on both the groups to measure the changes in the groups. The difference between the measurements can be calculated statistically. The criterion for conducting this technique is that both the groups should be similar in every possible aspect. The basic philosophy behind this design is that both the groups would be equally affected by the presence of any extraneous variable.

For example, this technique can be used to measure the effectiveness of an advertisement. For this, two groups will be randomly selected, named 'experimental group' and 'control group' respectively. A questionnaire will be given to them to measure their perspective regarding the product. After that members of the experimental group will be shown the advertisement. After showing the advertisement, the measurement will be taken from both groups to see the changes in perspective regarding the product.

Randomisation	Group	Pre-test	Treatment	Post-test
R	**Experimental Group**	O_1	X	O_2
	A group of People	Response to Questionnaire	Product Advertisement	Response to Questionnaire
R	**Control Group**	O_3		O_4
	A group of People	Response to Questionnaire		Response to Questionnaire

Experimental Variable Effect= $(O_2 - O_1) - (O_4 - O_3)$

2) **Posttest-Only Control Group Design:** In posttest-only control group design, experimental and control group are selected from the target population, which are identical in nature. Before the introduction of the treatment, no measurement is taken from any group. Only after the introduction of the treatment, the level of phenomenon is measured in both the control and experimental groups. The resulting effect of the variable may be calculated by subtracting the control group level from the experimental group level. The above example can be implemented through this technique also. The difference would be that researchers would not test the perspective of group of people before showing the advertisement related to them. The perspective of the people would be measured right after showing the advertisement.

Randomisation	Group	Treatment	Post-test
R	**Experimental Group**	X	O_1
	A Group of People	Product Advertisement	Response to Questionnaire
R	**Control Group**		O_2
	A Group of People		Response to Questionnaire

Experimental Variable Effect = $(O_1 - O_2)$

3) **Solomon Four-Group Design:** Solomon four-group is an improvement over pretest-posttest design. This design introduces two additional control groups, which helps the researchers to assess the influence of confounding variables on the measurement. It also allows estimating the changes caused due to pretest on the subjects. In this experimental design, different combinations of tests are conducted to identify the extraneous and confounding variables and reduce their effects on the outcome. Although this design is beneficial from the perspective of accuracy, but executing this design incurs huge cost and takes a lot of researcher's time. **For example**, 100 teachers are selected and randomly divided into four groups of 25 teachers and named 'experimental group-1', 'experimental group-2', 'control group-1', and 'control group-2' respectively. Now, first experimental group would be given a faculty morale questionnaire and would receive the treatment in form of sensitivity training. The control would be given the questionnaire and would not receive any treatment. On the other hand, second experimental group would receive sensitivity training and the second control group will directly be postested in form of questionnaire. As soon as the groups are pretested and receive treatments, they would be again given the questionnaire. Now, the effects on various groups of teachers can be measured by comparing the groups.

Randomisation	Group	Pre-test	Treatment	Post-test
R	**Experimental Group 1**	O_1	X	O_2
	25 teachers	Faculty Morale Questionnaire	Sensitivity Training	Faculty Morale Questionnaire
R	**Control Group 1**	O_3		O_4
	25 teachers	Faculty Morale Questionnaire		Faculty Morale Questionnaire
R	**Experimental Group 2**		X	O_5
	25 teachers		Sensitivity Training	Faculty Morale Questionnaire
R	**Control Group 2**			O_6
	25 teachers			Faculty Morale Questionnaire

2.4.6.3. Quasi-Experimental Designs

Quasi-experimental research designs are applied when true experimental designs cannot be applied. These techniques are easy and economical in nature. These research designs are suitable for following conditions:

1) Researchers have complete control over the measurements.
2) Researchers cannot control the projection of treatments and randomisation of test units is not possible.

Some of the major quasi-experimental designs are as follows:

1) **Time-Series Design:** In this design, the researcher takes a series of periodic measurements on the dependent variable. The treatment is introduced either manually by the researcher or occurs naturally. As soon as the treatment occurs, the periodic effects in measurements are estimated.

   By measuring the dependent variable before and after the treatment, researcher becomes able to identify and control the extraneous variables. Periodic assessment not only affects the immediate measurement to the treatment, but also affects all the measurements. By applying randomisation in selection of test units biasness in research outcomes can be reduced. **For example,** the death rate of people due to Ebola disease, can be measured periodically, i. e., before and after the medication of people in successive years to measure the effects.

   While the people suffering from this disease can be measured before the treatment, the people can also be observed after introducing the treatment in form of medication. This will enable the researchers to see the effect of medication on people.

Randomisation	Group	Pretest			Treatment	Posttest		
	Experimental Group	O_1	O_2	O_3	X	O_4	O_5	O_6
R	A group of people suffering from Ebola	Death Rate (Before 3 years)	Death Rate (Before 2 years)	Death Rate (Before 1 years)	Medication	Death Rate (After 1 year)	Death Rate (After 2 year)	Death Rate (After 3 years)

2) **Multiple Time-Series Design:** This design is slightly different from the time series design in a way that it includes a control group for measurement. The efficiency of this design depends on the fact that the effect of treatment needs to be measured twice, i.e., against the measurements of experimental group before the treatment, and against the control group as well. Another consideration while performing this research is to select the test units of control group carefully. Taking the above example, the same observation can be made with the help of a control group. The members of control group would not receive the medication. This technique helps in drawing the conclusions in a better way.

Randomisation	Group	Pretest			Treatment	Posttest		
	Experimental Group	O_1	O_2	O_3	X	O_4	O_5	O_6
R	A group of people suffering from Ebola	Death Rate (Before 3 years)	Death Rate (Before 2 years)	Death Rate (Before 1 years)	Medication	Death Rate (After 1 year)	Death Rate (After 2 year)	Death Rate (After 3 years)
	Control Group	O_1	O_2	O_3	–	O_4	O_5	O_6
R	A group of people suffering from Ebola	Death Rate (Before 3 years)	Death Rate (Before 2 years)	Death Rate (Before 1 years)		Death Rate (After 1 year)	Death Rate (After 2 year)	Death Rate (After 3 years)

2.4.6.4. Statistical Designs

The most common statistical designs are as follows:

1) **Randomised Block Design:** Randomised block design has evolved from agricultural research, where the researcher introduces various treatments to different blocks of land, so that their effects on the yield of crop can be assessed. Though there may be difference in the characteristics of land due to which the yield of crop can be affected. To identify the differential factors, the researchers introduce the treatments to the plots in each block randomly. The number of plots in a block is equal to the number of treatments, so that plots from each block can be selected for different treatment. As soon as the treatment is introduced, the production of crop is measured by using statistical techniques to analyse the effect of treatment.

2) **Latin Squares Design:** In this research technique, the researcher aims to control the variation in two factors. The design forms a square as there is equal number of rows and columns. This technique is adopted to identify the extraneous variable causing the change. In this research, all the possible combinations of these two variables can be estimated multiple times. This design is used to reduce the effect of nuisance factors. An important criterion for conducting this research is that the number of many test units should be equal to the number of treatments.

3) **Factorial Design:** In factorial experimental design the researcher tests two or more variables at the same time. It tries to find out whether the two variables combine to form the observed response or they combine independently. This technique is suitable when there are three or more experimental variables, and the test units are selected randomly. The major disadvantage of this method is that it involves complex calculations.

2.4.7. Validity of Findings

The degree to which a measure achieves its claims is referred to as validity. There are two distinct types of validity, i.e., external and internal. Both of these validities have to be weighed in order to determine the results of an experimental research design. Internal validity determines whether the cause of proven experimental relationship is clearly known whereas external validity is the degree to which the conclusions of an experiment can be generalised to different times, settings, persons and the world at large. Founding a certain relationship between the dependent and independent variables of a research is the prime objective of the research design. The extent to which the design accomplishes this objective is called the validity of the design.

Therefore, the two associated but distinct aspects of measurement of validity of the experiments are:
1) Internal validity and
2) External validity.

2.4.7.1. Internal Validity of Experiments

The degree of correctness of an experiment is identified by internal validity. It tries to establish a degree of certainty between the dependent and independent variables, i.e., it checks if any change in the dependent variable is the outcome of any change in the independent variables. Therefore, internal validity studies that whether the variables under study or those external to the research are responsible for the observed effects on the test subjects. Making effective conclusions becomes difficult when the effects are caused by variables external to the research. Thus, before drawing any conclusions about the effects of any experiment, it is critical that the experiment qualifies the internal validity as the results of the experiment might be contradictory without it. It is also essential to keep a control on the variables that are external to the experiment in order to effectively establish internal validity.

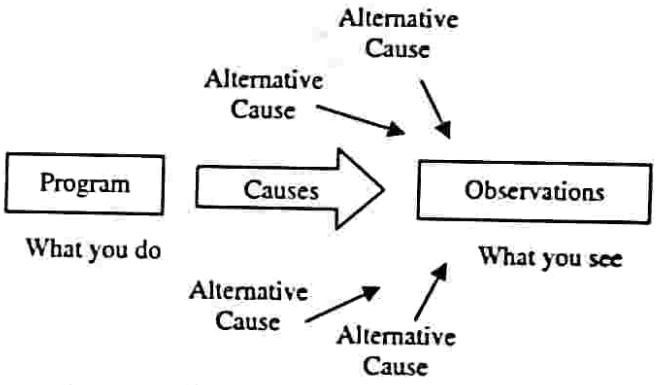
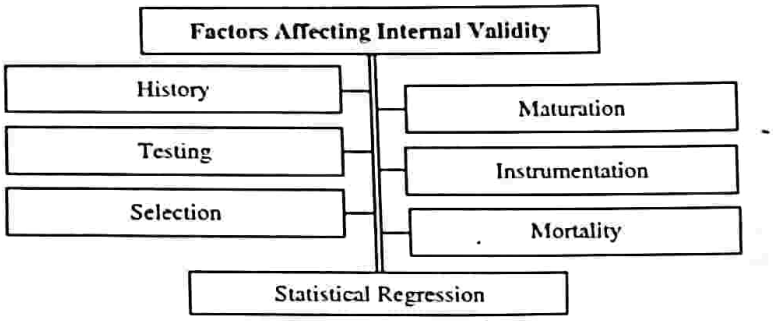


Figure 2.3: Internal Validity of Experiments

An estimated fact about the interpretations of the causal or cause-effect relationships is delivered by the internal validity of the experiments. Therefore, experiments having causal relationships are the only experiments where internal validity is relevant. **For example**, an experiment conducted in a laboratory setting improves the internal validity as there is a strict control on the external factors. Suppose, if one wants to establish a relationship between a specific smell and increase in the productivity among workers, then an experiment can be conducted in the workplace with a strict control in the airflow so that it can be made sure that the required intensity and amount of that smell is present in the air. Also, conducting an experiment in a lab enables to regulate certain other factors such as light, temperature, sound, density, etc. If smell is the only factor that is varying among the workers, then it can be concluded that the smell is responsible for any changes in the performance of the workers.

Factors Affecting Internal Validity

Variables and factors external to the experiment can potentially hamper the internal validity. These are as follows:



1) **History:** When a change (except the experimental treatment) occurs during the extent of an experiment and influences the dependent variable, it is referred to as an effect caused by history. **For example**, change in the marketing strategies of competitors in the test marketing experiment. The effects of history can be majorly seen in the repeated measures experiments that extend over a period of time. The cohort effect can be regarded as a special case of history effects where when one experiment group members encounter different historical situations than other experimental group members resulting in change in the dependent variable.

2) **Maturation:** Internal validity will be lower if the experiments are conducted over a longer period of time as the test subjects will grow old and gain more experience. With growth and experience of the subjects, these effects occur naturally, as these are the function of time. **For example**, a year-long experiment is conducted to see the effect of a new remuneration programme on the sales productivity of the sales force. The test subjects (sales force) would gain more knowledge or experience or simply mature during that time period. Therefore, internal validity will be lower as one cannot measure whether the improvement in the productivity is due to the new remuneration programme or maturity factor.

3) **Testing:** Sometimes the responses that are about to be collected from the subjects with the help of given experiments get affected or altered due to initial test or measurement, it is called testing or pre-testing effect. The only experiment where such effect is found is before-and-after experiment. Such experiments require repeated measures to draw any conclusion; here before administering any experimental treatment, a starting point measure is essential. **For example**, response of students taking intelligence tests for the second time will be better compared to those taking them for the first time. Testing effect makes the subject more conscious of the different dimensions of a particular problem, more attentive to experimental conditions and more aware to socially accepted answers.

4) **Instrumentation:** Internal validity may also be affected when the procedures for the experimentation, the interviewers, or the wording of the questions are changed in an experiment. This is referred as instrumentation effect. These effects are common in experiments with repeated measures. **For example**, in a before and after study, if the questions in after-experiment are asked by the same interviewers, this may result in lowering the internal validity. This is because the interviewing skills of the same interviewers might improve with practice or they may simply rephrase the questions due to boredom. Therefore, new interviewers are brought in to ask the questions. However, the new ones are also external factors due to variation in the instrumentation. Instrumentation variation or decay might occur due to various different sources.

5) **Selection:** The selection effects occur when there is a bias in the selection of the test subjects for the experiment. It is a type of sample bias.

6) **Mortality:** It is a type of effect which occurs when the test subjects no longer remain a part of the experiment group. Sample bias may occur due to such effects when the members of a group leave in larger proportions than other group members. They leave the experiment before it is finished. It is also known as sample attrition. This mainly arises when the experiment stretches longer.

7) **Statistical Regression:** Such effects occur when the experimental groups are chosen based on their extreme characteristics or scores.

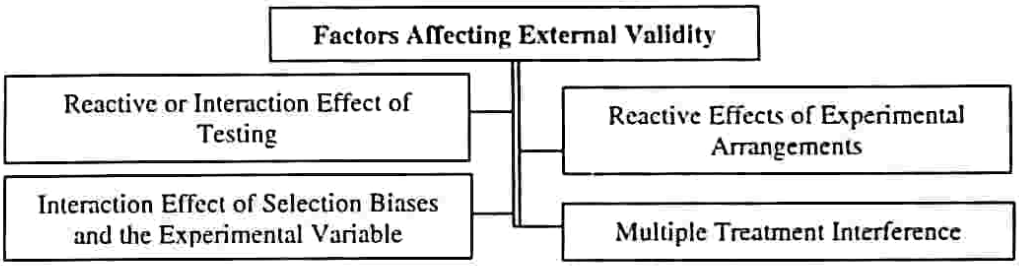
2.4.7.2. External Validity of Experiments

The extent, to which the results of an experiment can be generalised across different times, persons or settings or beyond the subjects at study, is referred as external validity. When the subjects in the sample really represent a population and when the experimentation results are applicable to different group of people or market segments, it leads to external validity. The level of external validity of an experiment truly defines the level of implication of the outcomes of that experiment to the real world, i.e., workplace, market segment, sales territory, etc. **For example**, the degree to which the results of an artificial retail experiment can be extended to the retail store of the actual world is depicted by external validity.

One question that needs to be answered is that to which degree the results of such lab experiments can be extended to real life situations. The lab experiments are conducted with minimum external factors and limited experimental conditions which considers everything else as constant. Therefore, the result of a lab experiment cannot accurately represent all the conditions that exist in the actual world. There will be difficulty for the researcher to repeat the experiment in a different setting if it lacks external validity.

Factors Affecting External Validity

There are certain factors that can hamper the external validity. These are as follows:


Factors Affecting External Validity
Reactive or Interaction Effect of Testing
Reactive Effects of Experimental Arrangements
Interaction Effect of Selection Biases and the Experimental Variable
Multiple Treatment Interference

1) **Reactive or Interaction Effect of Testing:** This type of effect arises when the response or sensitivity of respondents towards the experimental variable may increase or decrease due to a pre-test. Due to this, the results of the experiment cannot be used to represent the actual world from which the respondents were chosen.
2) **Reactive Effects of Experimental Arrangements:** When in non-experimental environment, the persons are exposed to experimental variables, their effects are difficult to generalise and this effect is termed as 'reactive effects of experimental arrangements'.
3) **Interaction Effect of Selection Biases and the Experimental Variable:** Interaction of the selection biases and experimental variable affects the external validity of the experiment. The findings cannot be implied to larger population or a market.
4) **Multiple Treatment Interference:** Sometimes, due to repetitive experiments the subjects become aware of different factors like socially accepted answers, experimental dimensions, etc. Such effects of previous treatments are difficult to erase. Therefore, they affect the responses of the subjects.

2.4.7.3. Trade-offs between Internal and External Validity

Experiments conducted in actual world scenarios tend to have much external validity as compared to the ones conducted in the labs. Therefore, marketing researchers should switch from internal to external validity. **For example**, an advertiser wishing to test the effectiveness of an advertisement with the help of a split-cable experiment knows that the ad commercial is going to be seen by the actual people of the world. But, it is also possible that some interference in the form of a telephone call, etc., might affect the experimental variable thus, reducing the internal validity of the study.

Field experiments have more external validity and less internal validity whereas the internal validity is higher in case of controlled factors in lab experiments. Therefore, it is preferred to test the conclusions of a lab experiment in the actual world also.

2.4.8. Application of Experimental Research Designs

Experimental research designs have the following applications:

1) **Understanding Consumer Behaviour:** By using the experimental research designs, the researchers observe the current behaviour of consumers. With the help of current behaviour, they try to predict the future behaviour and to reveal the past behaviour as well. The psychologists of experimental research field are aware of very wide range of phenomena such as learning, personality, cognitive development, etc.

2) **In the Field of Sales:** Researchers use the methods of experimental research in order to evaluate the effectiveness of the promotional efforts of the company. It also helps in identifying the affect that the advertisements made on the consumer buying behaviour.

3) **Searching for Facts:** These designs are used by the researchers to extract the research related information. In this, the variables of the experiment are used to thoroughly understand the problem under inspection.

4) **Testing Validity of Empirical Proposition:** Researchers use these research designs in order to validate the assumptions of a theory and to compare the actual outcome with the intended outcome. This testing assists the researchers in measuring the consistency and authenticity of research.

5) **Business Communication:** Business communication is a very crucial aspect of a business and therefore, it is very important to make the business communication effective. Some of the aspects of business communication, if studied with the help of experimental research designs, may provide valuable output and information to the marketers.

2.4.9. Significance of Experimental Research Design

The significance of experimental research can be understood by following points:

1) **Cause and Effect:** The major advantage of experimental research design is that the cause of a particular event can be identified here. Other research designs either explain the event or describe the population, but do not determine the cause behind an effect. By conducting an experiment using random assignments, and participants unknown to the causing factors, would enable the researcher to observe any deviation due to the experiment.

2) **Reliable Outcomes:** Another benefit of experimental research is that the outcomes of experimental researches are highly reliable, as the procedure is conducted in a controlled environment using quantitative measures, and random assignments. This distinctive feature allows the researchers to generalise the findings as well as replicate the experiment with similar sample drawn from the same larger population. The samples drawn are true representative of the population.

3) **Provides Helpful Insight:** These designs are very useful in providing important insight for solving immediate problem. **For example**, by researching on different techniques of motivation, a suitable and effective motivation technique may be developed for the employees of an organisation.

4) **Control over Variables:** In experimental research design, the researcher can control different variables in the environment. Thus the researcher is able to determine the individual impact of all possible variables. Moreover, the interrelationship among variables can also be measured more effectively.

2.4.10. Limitations of Experimental Research Design

Experimental research design has following limitations:

1) **Artificiality:** The experiments are performed in artificial settings which lack real-life conditions. Such unnatural environment disturbs the genuine behaviour of respondents, hence producing a false picture. As these experiments are entirely different from the real-life environment, the outcomes of such experiments may not be used for other live situations.

2) **Biasness by Researchers:** Since in experiments researchers input the causing variables manually, therefore it is susceptible to "selection bias" on the part of the researcher. Many times because of convenience in execution, the researcher can manipulate the inputs. As a result, the outcomes are not completely reliable and valid. Moreover, the easiest and cost-effective sample is selected by the researcher for the study and findings of this study are generalised for further use.

3) **Modified Responses:** The responses of the participants may be influenced by many factors in the surrounding. Instead of giving genuine responses, the respondents may respondent what the researcher wants to hear or may modify the response as per the subject of research.

4) **Impossible to Control All the Variables:** The much known feature of experimental design is the control over different variables present in the environment. However, all the factors cannot be entirely controlled as it is not possible to identify all the potential variables affecting the experiment. Thus, it is very difficult for the researcher to have complete control over the thinking and behaviour of the respondents.

5) **Uncertainty of Actual Responses:** The responses given by the respondents in such designs are uncertain as it is difficult to differentiate between the true and manipulated responses.

2.4.11. Variables in Research

Those factors and elements that show some variations at different point of time and in different situations are known as variables. Variables also have the ability to impact the outcome of any study. Nonetheless, they are crucial for any study because with the help of variables a researcher is able to identify the differences.

As the name suggests, variables have minimum two values. Some of the variables are tangible and visible in nature like weight, height, gender, etc., whereas others are very descriptive such as, IQ, perception, beliefs, etiquettes, self-esteem, etc. Hence, it can be said that variables are those facets which one person has different from the others.

In the process of designing of quantitative research, one of the important steps is to identify the variables associated with the topic of research. On the other hand, qualitative researchers do not give as much consideration to the variables as their quantitative counterparts give, yet they also have to outline the phenomena they are going to do research on. The most important categories of variables are discussed in detail. Though they are explained under the heads of quantitative research methods, the qualitative research also comprises of similar examples.

2.4.11.1. Independent and Dependent Variables

Variables share mainly two types of relationship among each other, they are as follows:

1) **Independent Variable (IV):** Independent variables are those variables which vary on their own but they also affect the other variable(s) under research. It is very likely that a variable which is independent for a particular study may be a variable under control for any other study. Similarly, in certain study the independent variables may slightly be correlated, then in such cases they are not said to be independent variable. **For example,** the relationship between crop yield and rainfall is such that the rainfall is an independent variable, whereas the crop yield depends on it. But, it is not necessary that the rainfall will act as an independent variable in all the situations.

2) **Dependent Variable (DV):** Dependent variables generally get affected by the changes of independent variables. As these variables change frequently, the need of measurement, monitoring, and prediction of these variables arise. Dependent variables are also known as criterion variable.

2.4.11.2. Concomitant Variable

Those variables whose values are generally available before the commencement of research and they are also correlated with the outcome of the research, are known as concomitant variables. Also, these varial les are not one of the reasons due to which the research is being conducted. The examples of such variables are covariates and blocks. How to include these variables in the research design is one of the major challenges of research design process. Strategies used to overcome this challenge are as follows:

1) Make use of concomitant variables as covariates.
2) Consider the concomitant variables as blocks and use them as the subject of research.
3) Provide certain range to the values of concomitant variables so that the range intervals can be used as blocks. **For example,** for the respondents of different age groups, divide the groups in the intervals of 20 years.

The concomitant variables cause the undesired variation among the other dependent and independent variables. This characteristic of the concomitant variables reduces the risk of biasness. On the other hand, these variables give rise to the error variance, which in turn reduces the chances of recognising the actual differences. To overcome these kinds of demerits, an ideal research design strategy is required which can reduce or nullify the effect of undesired variations caused by the concomitant variables. There exist two such strategies, which are as follows:

1) Experimental control and
2) Statistical control

2.4.11.3. Moderating Variables

Every relationship comprises of minimum one dependent and independent variable. The second important independent variable under consideratiou is known as moderating variable. Such variables are involved because of the belief that it can make an important contribution towards the relationship of dependent and independent

variables. **For example,** the incentive-based compensation structure leads to improved performance of the employees and this effect is more evident among the young employees. Hence, in the stated examples, incentive-based compensation structure is the independent variable and performance of employees is the dependent variable, whereas improvement of performance mainly seen in the young employees is the moderating variable.

2.4.11.4. Extraneous Variables

In any situation, the extraneous variables exist in a large number and it is very likely that they influence the relationship under consideration. But, the effect of these variables is very less, and therefore most of them can be ignored. And the remaining, which might be of some importance, are either considered as independent or as moderating variables. **For example,** issuing of discount coupon on the purchase of raw cereals will not heavily affect the sale because of numerous reasons such as, people may think that the government is about to increase the tax rates, election is scheduled, heavy rain is forecasted, etc.

2.4.11.5. Intervening Variables

According to Tuckman, "The intervening variable is that factor which theoretically affects the observed phenomenon but cannot be seen, measured, or manipulated; its effect must be inferred from the effects of the independent and moderator variables on the observed phenomenon

In connection with the above mentioned example of incentive-based compensation structure, some employees can perceive that their overall salary is increased and some may derive job satisfaction from it. These variables can be termed as intervening variables.

2.5. MEASUREMENT

2.5.1. Introduction

Organisations involve lots of decision-making in various functional areas like production, marketing, finance and personnel management. Various marketing decisions are heavily influenced by the predispositions or attitudes of the present and potential customers of the company and its products. Measurement is the process by which the organisation observes and records the observations that have been gathered as a result of some research activities. In other words, measurement can be defined as "the process of mapping the aspects of an area onto some other areas as per some rules". **For example,** researchers may wish to measure the percentage of people who make purchases the products for their company. For measurement, a scale is needed to be developed in the range that refers to a particular set, according to set theory. After this, mapping is carried-out on the observations, which are based on defined scale.

According to G.C. Helmstadter, "Measurement is a process of obtaining a numerical description of the extent to which a person or object possesses some characteristics".

According to Johan Galtung, "Measurement is the mapping of the values on a set of numbers".

According to Kerlinger, "Measurement is the assignment of numerals to objects or events according to rules".

The major application of such data is in the area of marketing where measurements are taken regarding predispositions or attitudes of current and potential customers of a company. By knowing about the attitudes of the customers, the marketing managers may take important decisions which are effective and beneficial to the company. Various areas of marketing where measurement techniques are used are product positioning, market segmentation, advertising message effectiveness, etc.

2.5.2. Measurement Process

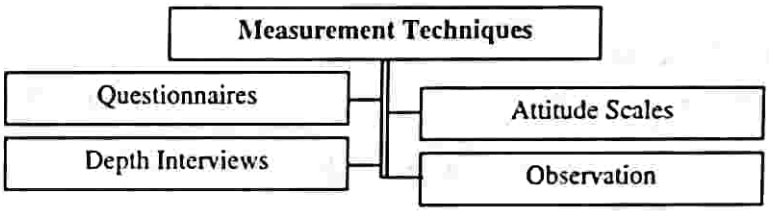
Following steps are involved in a typical measurement process:

1) **Developing Behavioural Categories:** Measurement process starts with the behavioural categorisation of different events to be measured. It is very crucial to categories events carefully so as to make the measurement process simple and appropriate.

2) **Selection of Appropriate Calculation Method:** After successfully categorising the events, the next step in measurement process is selecting appropriate calculation method for different behavioural categories. The different calculation methods are as follows:
   i) **Frequency Method:** In this method, frequency counts are used for calculations. Number of occurrences of a particular event in a definite time period is called its frequency count. Behaviours or events which occur number of times within a definite time period, occur for short durations, or have a sharp beginning or ending, are calculated with the help of frequency method.
   ii) **Duration Method:** In this method duration of an individual being involved in a particular behaviour or activity within a fixed time limit is calculated.
   iii) **Interval Method:** In this method, the whole observation time limit is divided into different intervals and these intervals are checked for a specific behaviour or activity.
3) **Using Multiple Observers:** The final step in measurement process is using multiple observations so as to measure inter-rater reliability. Observations used in measurement process are as follows:
   i) **Naturalistic Observation:** The naturalistic observation involves observing in a natural or real environment. Here, the actual behaviour of the respondents is observed and recorded, which is free from manipulations.
   ii) **Participant Observation:** In this type of observation, the researcher joins the group of participants as an individual participant and therefore, observes their behaviour.
   iii) **Contrived Observation:** When a simulated environment is created to observe the natural behaviour of the respondents, it is called contrived or structured observation. This type of observation eliminates the need of observing respondents in natural setting.

2.5.3. Measurement Techniques

There are four possible measurement techniques, which are discussed below:



1) **Questionnaires:** The questionnaire is an inventory of questions used to seek information from respondents on different topics like behaviour, demographic and psychographic details, opinions, attitudes, beliefs, feelings, etc. The questions are designed for a particular study and are validated before concluding.
2) **Attitude Scales:** Attitude seeks responses on the feelings of respondents towards a particular object. Attitude scales can be of different types like:
   i) Rating scales make a respondent to place an object on a scale which is numerically numbered.
   ii) Ranking scales require the respondents to compare a set of objects and rate them between '1' to '10', where, '1' stands at a highest position and '10' stands at a lowest position.
3) **Depth Interviews:** In depth interviews, the respondents have complete freedom to express their feelings without any fear of rejection or meeting opposition from others. The responses which are received from the respondents are recorded in specially designed formats. This technique is used when the researcher wants to gather in-depth information about the feelings and opinions of respondents or when the researcher wants to examine some new issue or aspect of the study. Many times, depth interviews are also used to provide clarity or perspective on the other gathered data. It helps to provide a more comprehensive picture on the data that has been gathered. In depth interviews, a technique should be used *in lieu* of focus interviews where it is felt that the respondents will not be comfortable talking about the topic in a group atmosphere or where the researcher wants to differentiate between individual opinions and group opinions on a topic of discussion. Depth interviews are also used where the researcher wants to refine questions for a future study or survey.
4) **Observation:** It is a direct technique of examining the behaviour or the results of the behaviour. This requires the researcher to observe the behaviour of an individual or a group of people. This observation

must be done in a natural setting and over an interval of time. The biggest advantage of this method is that it increases the credibility of the research process. It utilises trained researchers who are unbiased regarding the research topic. By observing the behaviour formally, the observers are often able to identify attitudes and predispositions which are often overlooked by researchers. The disadvantage is that observation is a time-taking process and the observers often find that their presence influences the behaviour of the people being observed and thus affects the reliability of the observation process.

2.5.4. Errors in Measurement

Any research process is prone to various types of errors. These errors can be categorised as being caused due to subject, researcher, environment or instrumentation. These can be explained as follows:

1) **Subject Factors:** The common sources of errors are the people who are the part of research activity. A subject, who is sick, fatigued, hungry, emotional, facing change in psychological state, etc., can cause an instrument error to creep into the research activity. Other causes of error can be the subject's familiarity with the research area especially while being observed, excessive friendly nature of the researcher, etc. Professional researchers ensure that issues which can cause bias or affect the response of the subjects are under control.

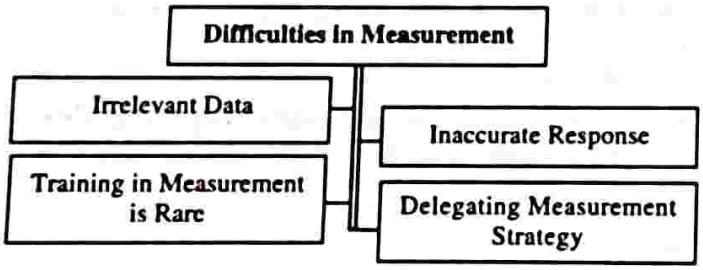
2) **Researcher Factors:** The researcher also puts a lot of effect on the outcome of the research activity. He can affect the research activity through his personal appearance, such as, his/her attire, general outlook, speech, behaviour, etc. If the researcher is unwell, tired, bored, aggravated or distracted, then this may affect the measurement process. Skilful researchers do not let their personal factors or state of mind affect the outcome of the research activity.

3) **Environmental Factors:** The physical environment in which the research is carried-out can also affect the research activity. Factors like the weather, lighting, temperature, external disturbances, noise, etc., can also affect the research activity. A professional researcher should ensure that proper conditions for conducting the research are fulfilled and that there is uniformity in all the areas where the research activity is being carried-out.

4) **Instrumentation Factors:** There are also other factors which can have a random impact on the outcome of the study. Some examples are vague questions, imprecise directions, inadequate sampling frame and design, unsuitable sequencing of the questions, etc. A good researcher should ensure that the questionnaire is tested in a pilot study before utilising the same so that all the sources of errors are identified and nullified.

2.5.5. Difficulties in Measurement

Measurement has the following difficulties:



1) **Irrelevant Data:** Measurement leads to the generation of enormous data. However, it is not necessary that the data is always relevant, the data may lack purpose at times. Sometimes, measurement forces the marketers to manipulate the real data for their own purposes.

2) **Inaccurate Response:** Respondents have a tendency of giving inaccurate responses in face-to-face interviews. It is very important that the research activity elicits the correct response from the respondents. Now-a-days, web-based surveys have made it possible to target a large target-segment, quickly and economically.

4) **Training in Measurement is Rare:** Measurement requires that people have necessary skills and knowledge in particular field. However, very few organisations invest in knowledge and skill building.

5) **Delegating Measurement Strategy:** Deciding the right metrics often requires that the incumbents not only have a big picture perspective but also the power to challenge the dominant marketing mind-sets of the organisation. This is often not possible for middle managers but requires involvement of top management. Measurement should not be delegated, as the quest for truth will then take a backseat in the organisation. It needs leadership and focus in the organisation so that a congenial environment is created in the organisation.

2.5.6. Criteria for Good Measurement

Seven important criteria are used for evaluating the measurement, which are as follows:

1) **Reliability:** Reliability is an important criterion for testing the measurement. When the results offered by the measuring instrument are consistent, it is called reliable. Although reliable instrument is not necessarily a valid instrument in its nature, but it leads to validity of the measurement.

2) **Validity:** The next criterion used for evaluating the measurement is its validity. The extent of measure to which a particular measuring instrument specifically measures is called its validity. It can also be denoted as utility. It also expresses the extent to which differences described by a measuring instrument between the two behaviours are true.

3) **Practicality:** Practicality is also a criterion for testing the measuring instrument. The extent, to which a particular measuring instrument is suitable, cost-effective and interpretable, denotes the practicality of the instrument.

4) **Sensitivity:** The next criterion for evaluating the measurement instrument is its sensitivity. A particular measuring instrument is said to be sensitive if all the variations in responses or stimuli are effectively measured by it. Measuring instruments dealing with 'Agree' or 'Disagree' types of responses are not so sensitive. A little modification is required in instruments so as to record more sensitive responses.

5) **Generalisability:** Generalisability is also an important criterion for testing the measuring instrument. The ability of data collection of an instrument from widespread respondents alongwith offering flexibility in its interpretation is called generalisabilty.

6) **Economy:** The choice of data collection method is also often dictated by economic factors. The rising cost of personal interviewing first led to an increased use of telephone surveys and subsequently to the current rise in Internet surveys. In standardised tests, the cost of test materials alone can be such a significant expense that it encourages multiple reuses.

7) **Convenience:** A measuring device passes the convenience test if it is easy to administer. A questionnaire or a measurement scale with a set of detailed but clear instructions, with examples, is easier to complete correctly than one that lacks these features. In a well-prepared study, it is not uncommon for the interviewer instructions to be several times longer than the interview questions. Naturally, the more complex the concepts and constructs, the greater is the need for clear and complete instructions.

2.6. SCALING

2.6.1. Introduction

A series of categories or items arranged in a progressive manner (in a continuous spectrum) based on magnitude or value is called 'scale'. Different responses of individuals are quantitatively placed on such scales.

Every scale includes a lowest point, a highest point and some intermediate points (representing a particular activity or attitude). If the first point or item on the scale is of highest degree, the second point is higher in nature than the third point; consequently, the third pint is higher in nature than the fourth point and so on.

The process of developing a continuum for placing the measured objects is called scaling. These measured objects may involve interests, opinions, attitude and other responses of the individuals. Thus, the next operation involved in measurement is the scaling process. In this, different qualitative aspects are associated with quantitative components.

Measurement is followed by scaling procedure in a research activity. Researchers always face the problem of how to measure or quantify abstract concepts and how to relate one individual's response to that with another response. Hence, the problem is two-fold. First is, how to quantify a response in absolute terms, and the second is, how to relate it with other responses. This problem is resolved by scaling process, or assigning the numbers or values to responses and positioning them on a common scale. Scaling can then be defined as, "creating a continuum with two extreme limits and few immediate values between them". Hence, scaling is the process or procedure of quantifying and measuring abstract concepts like attitudes, opinions, emotions, etc. Scaling also quantitatively determines the position of an individual in a range of values.

According to Edwards, scaling can be defined as, "procedure for the assignment of numbers (or other symbols) to a property of objects in order to impart some of the characteristics of numbers to the properties in question."

In a scale, the values are progressively placed according to their value or magnitude in such a manner that moving forward in a scale will depict an item to be always higher than the immediate lower one.

2.6.2. Process of Scale Construction: Construction of Instrument

Among all the commonly used direct techniques to measure attitudes, like word-association tests, sentence-completion tests, story-telling, performance of 'objective' tasks, physiological reactions, etc., the 'self-report method' is the most popular. In this method, the respondent is asked to give his opinion about a particular object freely. Described below is a step-by- step guide on how to construct a self-report:

1) **Gathering Related Variables:** Once the subject of enquiry has been decided, it is time to collect all possible variables and related statements, which are then examined to remove those that are imprecise and ambiguous, so that the questionnaire is easily comprehensible and accurately answerable. Utmost care should be taken to ensure the use of simple, easily understandable language.

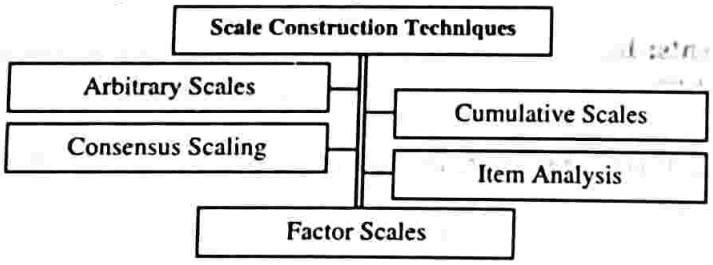
2) **Shortlisting the Variables:** Once the pool of variables or questions has been finalised, it is time for scrutinising the variables to ensure that the question or variable can be included in the scale. Some of the criteria for selecting the variables are as follows:
   i) Relevant with the enquiry,
   ii) Indispensible,
   iii) Easily comprehensible,
   iv) Accurately answerable,
   v) Covers all the possible dimensions and angles of the subject of enquiry.

   Before finalising, its efficacy is needed to be tested either through a sample tested on a dummy or by assigning the task to a group of experts.

3) **Formation of Scale:** Once the variables have been finalised, the scale is then tested for its validity and reliability, before being put to use in a survey.

2.6.3. Scale Construction Techniques

Techniques used in developing set of items or categories in a progressive manner (in a continuous spectrum) so as to measure an individual's attitude towards given event or object, refers to scale construction techniques. Different scale construction techniques used in scaling are as follows:



1) **Arbitrary Scales:** In this technique, large number of items or categories, which are able to represent the concept under study are collected and (then) measured in terms of same characteristic. Subjective selection of the researcher plays an important role here. Firstly, few related statements or items are selected by the researcher, and then these statements are filtered for being included in the measuring instrument. A list of filtered statements is presented to the respondents and they are required to tick the most suitable one.

Cumulative Scales: A series of statements is used in developing scale for the respondents in cumulative scales. These are also called 'Louis Guttman's scales'. These scales require respondents to show their agreement or disagreement over the statements. These scales are called cumulative scales because a cumulative series is formed by different statements here. **For example,** the confirmation of an extreme position item should also lead to the confirmation of less extreme position items.

Consensus Scaling: This method of scaling was given by **L.L. Thurstone.** In this, a panel of judges uses different attributes like attitude, relevance and ambiguity factor so as to select items or categories. Generally, differential scales are created by this method, which focus on measuring attitudes of respondents concerning specific issues like religion, war, etc. These are the most suitable scales for recording only a single attitude of the given concept. A high level of cost and effort is needed to create such scales. Judges' own attitudes may affect their functioning of assigning values to different statements.

Item Analysis: In this type of scale construction technique, a group of respondents is given a test created by selecting different individual items. Following steps are involved in this technique:

i) Firstly, large number of items expressing their positive or negative aspects is selected.

ii) Then, a group of respondents assigns scores to them.

iii) Then for each respondent, total scores for all items are calculated. Then using these scores, they are divided into four constructs. Two middle constructs are then eliminated from the calculation.

iv) Then average score is calculated separately for each item.

v) T-test is then used to compare average of items of different groups to select items with noteworthy t-values.

In this, different statements expressing the positive or negative attitude towards the selected object are used to create the scale and the respondents are asked to check the most suitable one. Thus, the agreement or disagreement of respondents over different statements is recorded.

The most common example of item analysis is Likert scale. In this, several degrees of agreement or disagreement (generally five, but sometimes three or seven) are used by the respondents to respond to different statements. This type of scale is very easy to develop.

Factor Scales: Several different techniques are involved in constructing such scales. The purpose of using different scales is to study multi-dimensional items, to find the relations between different dimensions and to identify any other dimensions of the items. In the end, limited set of factors are available each having interrelated dimensions. Scales developed through this technique are as follows:

i) **Q-Sort Technique:** In this, the respondent is asked to sort the different given statements into prefixed categories.

ii) **Semantic Differential (SD):** Factor analysis of assumed interval scales results in semantic differential scales.

iii) **Stapel Scale:** It is a non-verbal rating scale having even number of scales. Single adjectives are used in items or categories. It is necessary to measure both the dimensions consequently. There is no need of assuming the ratings or the interval equality.

iv) **Multi-Dimensional Scaling:** In multi-dimensional scaling, a multi-dimensional space is assumed to be present. A set of techniques are developed to deal with such multi-dimensional space.

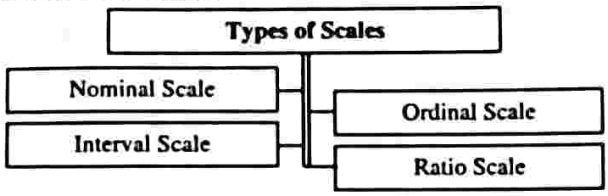
v) **Standardised Instruments:** In this, an available measuring instrument is selected for data collection. No new measuring instruments are developed. The opinion of expert is taken for selecting such standardised instruments.

Table 2.1: Different Scales for Measuring Attitudes of People

Name of Scale Construction Approach	Name of Scales Developed
1) Arbitrary approach	Arbitrary scales
2) Consensus scale approach	Differential scales (such as Thurstone Differential scale)
3) Item analysis approach	Summated scales (such as Likert Scale)
4) Cumulative scale approach	Cumulative scales (such as Guttman's Scalogram) Factor scales (such as Osgood's Semantic
5) Factor analysis approach	Differential, Multi-dimensional Scaling, etc.)

2.6.4. Types of Scales

There are basically four measurement scales:



2.6.4.1. Nominal Scale

This is the most fundamental form of measurement scale. These scales are not used to measure the value of an object, but to categorise or classify the object. The values represented in these scales need not to be necessarily a quantitative value. This makes it qualitative in nature. The nominal scales are used extensively by market researchers.

Nominal scales are essentially arbitrary because a researcher can assign any label to any category, without distorting the results. While the statistical measurements like mean and median cannot be calculated in the outcome of these scales, the findings of a nominal scale can be further subjected to statistical tools like mode, average, binomial and chi-square tests.

Examples of nominal scales can be:

1) What is your gender (tick 'M'-Male and 'F'-Female)? ___
   i) M
   ii) F
2) What is your hair colour? (tick 'A'-Brown, 'B'-Black, 'C'-Blonde, 'D'-Gray, 'E'-Other)
   i) A
   ii) B
   iii) C
   iv) D
   v) E

Numbers can also be assigned to the categories, but those would be treated as merely 'labels' in order to categorise the items or people in a group. Typically, nominal scales are used to ascertain characteristics like gender, ethnicity, backgrounds, tastes, preferences, etc., and not their intensity.

2.6.4.2. Ordinal Scale

While nominal scale focuses on categorising or classifying individuals or their responses, the ordinal scale seeks to rank them on the basis of their characteristics. In other words, it deals with relative positioning of an item on the basis of the characteristics of other items on the scale.

The participants of the research rank the objects as per their preferences and tastes. Therefore, the respondents are required to rank the objects from highest to lowest preferential order.

Thus, in ordinal scale, the responses have nominal properties but these scales go a step further and attempt to relatively quantify them by assigning relative values. It would be pertinent to point out here that one cannot quantify the difference between the two variables. These are essentially ranking scales, used extensively by market researchers to determine customer preferences and choices. It may be noted that any data collected through interviews or other methods of interrogation, always have ordinal properties.

For example, consumers may be asked to rank five popular brands of ice cream on a scale of 1 to 5, with 1 representing the most preferred and 5 representing the least.

1) Amul ___
2) Kwality Walls ___
3) Mother Dairy ___
4) Cream Bell ___
5) Vadilal ___

2.6.4.3. Interval Scale

Interval scale is the improvement or refinement over ordinal scale. Here, absolute values are assigned to the variables. Therefore, the difference between two variables is also equal. The inputs collected from interval can be easily computed with the help of Mean, Standard Deviation, etc.

For example, the difference between 100 degrees and 110 degrees is the same as between 60 degrees and 70 degrees, i.e., 10 degrees.

Another example of interval scale can be:

What is your age? (tick the correct range)

1) Below 10 years ___
2) 10 to 20 years ___
3) 20 to 30 years ___
4) 30 to 40 years ___
5) 40 to 50 years ___
6) 50 to 60 years ___
7) Above 60 years ___

The difference between all the values is same in the above example.

2.6.4.4. Ratio Scale

Ratio scale is the most refined and sophisticated form of scales used primarily in physical sciences. While in interval scales, variables have a relative value, in ratio scale, the variables do not have a relative value but an absolute value. Hence, they incorporate the value for absence of any characteristics in an object. This absence can be denoted with the value 'zero'. It is the basic differentiator between an interval and a ratio scale.

The data obtained through a ratio scale makes the outcome a meaningful and scientific interpretation.

Ratio scales are endowed with the characteristics of interval scales and the ratios of the numbers or values on these scales provide better and important understanding regarding the analysis. In fact, when responses on descriptive variables are obtained through open-ended questions, they display ratio-scale properties and features. Consider the following few examples:

1) **The Kelvin Scale:** 100 K is twice as hot as 50 K. The difference between values is meaningful and can be ordered.
2) **Weight:** 100 kg is twice as heavy as 50 kg. The values can be arranged in an order (ascending/descending).

Summary of Measurement Scales

Table 2.2: Summary of Measurement Scales

Criteria	Nominal	Ordinal	Interval	Ratio
1) Properties of Measurement	Labelling	Labelling and ranking	Labelling, ranking and equal intervals	Labelling, ranking, equal intervals and zero point
2) Nature of Measurement	Classifying	Ranking	Scoring	Scoring
3) Nature of Underlying Construct	Discrete	Discrete or continuous	Continuous	Continuous
4) Mathematical Functions	Mode, average, binomial and chi-square tests.	Mode or median.	Mean, Standard Deviation, etc.	Mode, Median, Mean, Standard Deviation, Coefficient of Variation.
5) Statistical tests	1) χ^2-test 2) Lambda test 3) Phi	1) U – test 2) Spearman's p 3) Gamma	1) Pearson's r 2) t - test	1) Pearson's r 2) t - test

2.6.5. Validity and Reliability of Instrument

These are described below:

I) **Validity:** Validity is the most important criterion and measures the degree to which the instrument measures what it is required to measure. It can also be considered as the utility of the instrument. It measures the extent to which the differences in the test measurements reflect the actual differences. **For example**, if a researcher is trying to examine the motivation level of employees, then he needs to look into a variety of other factors as well. Say, if he considers only absenteeism, then it is not a valid measure as absenteeism may also happen due to other causes like illness, personal reasons, family reasons, etc.

Validity can be measured by following techniques:

i) **Face Validity:** Face validity is the easiest among the various types of validity. It measures one single item on a test or all the items and tries to measure how well the item expresses the meaning of the test. **For example**, the test item "I think I should buy a car" is an example of item which has face validity as item measures intention to purchase a car. The downside of face validity is that respondents can often hide their responses or exaggerate their responses so that the response becomes manipulated. In fact, many psychometricians like tests which do not have face validity but general validity. Test items which measure what they are supposed to measure but have no face validity, will be more difficult to manipulate by the respondents. Though items which do not have face validity have some good features, but in the long-run, it is better if the test items have some face validity.

ii) **Content Validity:** Content validity refers to how adequate the selected variables are measuring the requirements. In other words, the scale that is being used should have all the required variables. **For example**, if a researcher wants to test the facilities of a hotel and if it includes the variables like locality, number of old customers, number of new customers, turnover, etc., then, it is clear that this scale will not have content validity as these variables are not adequate to answer the research objective. Instead, the researcher should include variables like the ambience, staffs, food, cleanliness, maintenance, medical facilities, etc. The selection and choice of research variables which are to be included in the scale for the purpose of the research activity, is a very difficult task.

iii) **Criterion Related Validity:** The criterion validity measures how well the data collected by the scale employed in the research work corresponds with the criterion variables. Criterion variables can be in the form of demographic and psychographic data, attitude and behaviour variables, or scores which have been derived from other scales. Criterion validity can be of two types depending on the time period of assessment:

a) **Concurrent Validity:** Concurrent validity is the type of criterion validity in which the data on the scale being employed and that of criterion validity are collected at the same time. The researcher can measure concurrent validity by using abridged forms of standardised personality inventories. The original instrument and the abridged version of the personalised inventory are administered over the respondents at the same time. Thereafter, the results are compared.

b) **Predictive Validity:** In predictive validity, the researcher gathers data on the scale and the criterion variable at different points of time.

iv) **Construct Validity:** In construct validity, the researcher tries to examine the characteristic or construct that the scale is measuring. When measuring construct validity, the researcher tries to answer questions like how the scale works and what kind of conclusions can be made regarding the research being carried-out. Construct validity is the most difficult and sophisticated kind of validity. It includes the following:

a) **Convergent Validity:** Convergent validity measures how well the scale converges or correlates with other measures of the same construct.

b) **Discriminant Validity:** This measures the opposite of the convergent validity. It measures how different the scale is from other measures of the same construct. It seeks to show the lack of correlation between various constructs.

c) **Nomological Validity:** Nomological validity measures the degree to which the scale correlates to other measures of different but related constructs in a theoretically predictable way. In this method, a theoretical model is developed which directs to further tests, deductions and inferences. This leads to the construction of a nomological net, in which several constructs can be related with each other.

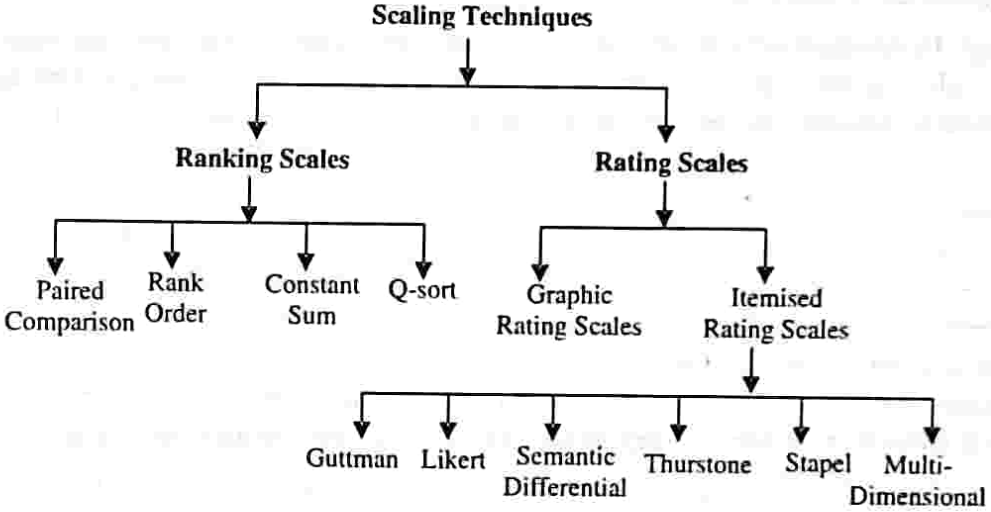
2) **Reliability:** Reliability refers to the ability of a measurement tool to provide consistent outcomes. It is one of the most important criteria for sound measurement. Any measuring instrument should fulfil the criteria of reliability. If an instrument is reliable, then it is considered as a valid instrument, but a valid instrument is not necessarily considered to be a reliable instrument.

Reliability is all about the precision and the accuracy of the measuring instrument. In other words, the result of the measuring instrument is reproducible or replicable. Reliability of a measuring instrument means that it produces consistently the same or similar results over different time periods and in different conditions. **For example**, if a thermometer measures the temperature of a city to be similar or same every time, then the thermometer is considered to be reliable. In other words, reliability is the ability of a measuring instrument to provide consistent results over time without error.

In some research conditions, a poor research methodology or faulty data collection methods can lead to low reliability. The quality of the responses received can be poor if the respondents are unable to understand the wordings of the questions or if they give incorrect answers to them. **For example**, if a Hindi questionnaire is administered in the rural Tamil Nadu, then the respondents will probably give erroneous feedback impacting the reliability of the questionnaire. Reliability varies between '0' and '1', with a higher reading denoting greater reliability.

2.6.6. Scaling Techniques

Attitude measurement scales can be constructed using following techniques:



2.6.6.1. Ranking Scales

Ranking scales offer the researchers to select the most preferred item of their choice between the two options. This method is most suitable for those cases where there are only two options available. But, at times it also results in a tie when more than two options are given. **For example**, a researcher may ask a lady to choose among two variants of toothpaste:

Option 'A'- Colgate
Option 'B'-Pepsodent

Most of the people would select any one option. But if the options are increased to four:
Option 'A'- Colgate
Option 'B'- Pepsodent
Option 'C'- Babool
Option 'D'- Close-Up

Then, the respondents may get confused in the options and instead of selecting any one option, they may end-up in ties. This problem can be solved by using following techniques:

1) **Paired-Comparison Scaling:** This method is one of the most elementary methods. In this method, the objects are paired with each other, and presented in front of one or more judges. The judges identify the

item in a pair that best satisfies the pre-set criteria. Now, the respondents select the item that is rated higher as per the criteria. The items can be anything such as products, services, environmental factors, etc. **For example**, following table shows the paired comparison of personal choices among seven different fruits:

	(A)Apple	(O)Orange	(M)Melon	(K)Kiwi	(B)Banana	(P)Pear	Total Stars for Each Fruit
(C) Cherries	C •••	C •	C ••	C •	C •	C •	Cherries get 9
(A)Apple		O •••	M •	A ••	B •	P •	Apples get 2
(O)Orange			M •	O ••	B •	P •	Oranges get 5
(M)Melon				M ••	B •	M ••	Melons get 7
(K)Kiwi					B •	K ••	Kiwis get 2
(B)Banana						P •	Bananas get 4
(P)Pear							Pears get 3

From the above table, it is clear that cherry is the most preferred fruit.

2) **Rank-Order Scaling:** Rank-order scales ask the respondents to rate an item in comparison to another item or a group of items, on the basis of some common criteria. It is the reason, why this technique is comparative in nature. **For example**, a respondent may be asked to rate a car on the basis of fuel efficiency, design, and comfort against three other cars.

3) **Constant-Sum Scaling:** In constant-sum scaling technique, the respondents are provided with a sum of units such as points, credits, money, etc., and are asked to allocate them to the objects. **For example**, a respondent may be asked to allocate the percentage to the daily activities in such a way that the total of percentage is 100%.
   i) Eating _____
   ii) Sleeping _____
   iii) Working _____
   iv) Hobby _____

4) **Q-Sort Scaling:** Q-sort scaling technique is a scale construction method in which the participants are asked to sort the objects or statements in several categories, in such a way that every object or statement falls into a category. This method attempts to determine the rank of an item with respect to other items.

   For example, the respondents may be asked to rate 50 statements of attitude among 11 piles with two extreme limits of "highly agreed" and "highly disagreed".

Merits of Ranking Scales

Ranking scales can be defined in following ways:

1) **Provides Insight about Choices and Preferences:** Ranking scales provide an insight to the choices and preferences of the participants. The responses given by the respondents have a particular value that can be easily quantified by average and can be ranked.

2) **Significant Research Tools:** Ranking techniques are important research tools that allow the researchers to know the tastes and preferences of the respondents as per the research objectives.

3) **Helps in Decision-Making:** Ranking scales help the researchers in making justified decisions that can satisfy the audiences by knowing their choices.

Demerits of Ranking Scales

Various demerits of ranking scales are as follows:

1) **Unable to Identify the Reasons of Responses:** Ranking scales are unable to identify the reasons behind selecting a particular option by the respondents. The ranking in these scales are relative in nature instead of being individual. This is the reason why these scales do not provide accurate results.

2) **Impossible to Give Same Rank to Two Items:** It is not possible to give the same ranking to two items, even if they have the same importance for the respondents.

3) **Distance between the Options may Vary:** The distance between two options in a scale may vary and there is no way to measure the distance.

4) **Risk of Biasness:** These scales may provide erroneous results as the respondents generally rank the first set of options more positively than the later ones, since the respondents fail to maintain focus till the later stage. It is called "order bias". It frequently happens when there is excessive number of options.

2.6.6.2. Rating Scales

Rating scales are non-comparative in nature. These scales are also called as "monadic" or "metric scale". In these scales, the respondents estimate a single item at a time and the outcome is either an interval or a ratio scale. Rating scales are frequently used by the market researchers due to their usefulness. These scales are suitable for those cases where the researcher wants to measure attitudes, perceptions, and other psychological aspects.

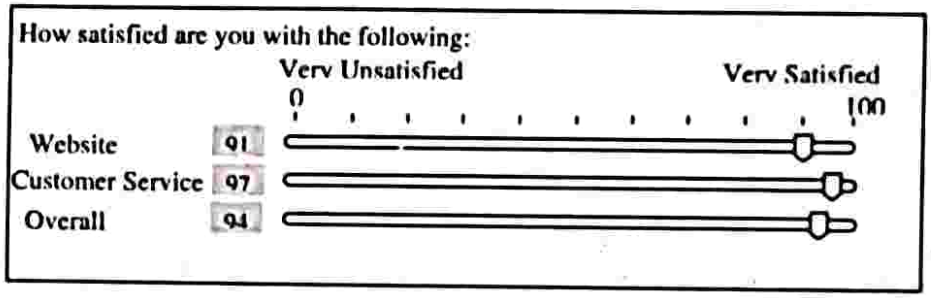
For example, 'weather' can be rated in the terms of 'humidity', 'illness' can be rated in the terms of 'severity', etc.

The outcomes of rating scales are useful for perceptual mapping. The purpose behind using rating scales is to assess the characteristics of objects without comparing the other objects.

Rating scales can be constructed by using following techniques:

1) **Graphic Rating Scale:** In graphic rating scale, a scale is constructed with two extreme options alongwith a range of options between those two options. The respondents here are required to place a mark on the preferable option. Graphic rating scales are also called as "Continuous Rating Scales".

   For example, customers of an online shopping website may be asked to rate their opinions regarding following three aspects:



   It is said that the distance between two extreme responses can be evaluated, and the accuracy of this scale increases with the increasing distance.

2) **Itemised Rating Scales:** Unlike graphic rating scales, the itemised rating scales have the description attached to every category of option. These categories are arranged in a particular order. The respondents are required to select one category that best describes the object. Itemised scales are of following types:

   i) **Guttman Scales/Scalogram Analysis:** Guttman scale is generally formulated in a dichotomous format or likert scale format. In this scale, few statements are arranged in accordance with their specificity in an ascending manner. The respondents are typically asked to respond in the form of "agree" or "disagree" to those statements with which they agree or disagree. The idea behind placing the statements in increasing specificity is that, the respondents start to agree with statements upto a certain level, after which they stop agreeing. These scales are used to determine the level of specificity of an attitude.

   These scales are quite complex to develop and take a lot of time and effort. These scales are formulated in the areas of political science, anthropology, public opinion, research and psychology. **For example**, a man may be asked to mark the statements with which he agrees regarding his family:

Place a check-mark against all statements with which you agree:	
I love my father	( )
I love my father more than my job	( )
I love my father more than my home	( )
I love my father more than my siblings	( )
I love my father more than my mother	( )

ii) **Likert Scale:** Likert scale is one of the most widely used scales in research. These scales are mostly used in questionnaires in surveys. Likert scale is psychometric in nature. In this technique, the scale is constructed with the help of five points where the levels of agreement regarding a statement are mentioned. The respondents are asked to select the level of agreement which is best suited as per the respondent. Generally, this scale is constructed using five points, but few researchers emphasise on using seven or nine points.

For example, a lady may be asked to select the level of agreement on following statement:

Environment of a family affects the mental growth of a child.

i)	Strongly disagree	(√)
ii)	Disagree	( )
iii)	Neither agree nor disagree	( )
iv)	Agree	( )
v)	Strongly agree	( )

iii) **Semantic Differential Scale:** This scale is constructed using seven points. At both the ends of the scale, two extreme values are associated related to a concept, object, or term. The respondents are asked to rate the object on that scale. It is usually conducted to know the perceptions about brand, company, and products. It also allows comparing the company's products with other competitor's products.

For example, a restaurant can ask about its taste and quality of food using this scale:
How was the taste and quality of food?
Very Satisfactory
a) +3
b) +2
c) +1
d) 0
e) -1
f) -2
g) -3
Very Unsatisfactory

iv) **Thurstone Scale:** Thurstone scale works on the concept of "Equal Appearing Intervals". This concept states that the distance between two options in a scale should be same in such a way that even when the respondents are not able to assign quantitative measures to the options, then also the difference can be estimated, so that their attitude can be determined accurately. This scale was developed by **L.L. Thurstone**. In this method, there are various statements which are sorted in 11 piles by the judges. The piles have values assigned to them that vary from most favourable, neutral, to most unfavourable. The researchers should eliminate those statements that are rated in a scattered way and assigned in different piles. Now, the researcher finds-out the scale value of remaining statements, i.e., determining the pile in which the median of distribution falls. Now, a statement is selected between the two from each of the 11 piles for constructing final scale. Finally, the item that has the narrowest range of rating is considered to be the most reliable one. **For example**, a respondent may be asked to select his opinion about harmful drugs in following ways:

Please check all those statements with which you agree.	
a) I don't approve of something that puts you out of a normal state of mind.	( )
b) It has its place.	( )
c) It corrupts the individual	( )
d) Drugs do some people a lot of good.	( )
e) Having never tried drugs, I can't say what effects they would have.	( )
f) If drugs are taken safely, their effect can be quite enjoyable.	( )
g) I think it is horrible and corrupting.	( )
h) It is usually the drug that people start on before addiction.	( )
i) It is perfectly healthy and should be legalised.	( )
j) Its use by an individual could be the beginning of a sad situation.	( )

v) **Stapel's Scale:** Staple scale is considered as an improvement over Semantic differential scale. It is a 10-item scale, where each item represents a word or a statement. The respondents in these scales are asked to rate an object using items on the scale which are numerically represented. The phrase or the word is associated at the centre of the scale and the scale is constructed vertically. At both the sides of the scale, positive and negative ratings are given that show the possibility of positivity and negativity of a statement. These scales are quite easy to use and the researchers need not to test the appropriateness of the two bipolar adjectives. Like Likert and Semantic differential scales, in Staple scale also, the items are at equal distance producing the results, which are interval-scaled in nature.

vi) **Multi-Dimensional Scaling:** Multi-dimensional scaling is a set consisting of various techniques for analysing data used to study consumer tastes and preferences. In this technique, the respondents are required to categorise the brands in various groups like similar, very similar, not similar, etc. A test of goodness of fit is carried-out on a large set of attributes, followed by a calculation about the lack of fit index. The prime motive behind conducting these tests is to identify a relatively small set of dimensions. As soon as the consumer's preferences are outlined, the respondents are asked to give their opinion regarding the product. This technique is used to find-out the important attributes that matter to the consumers.

Merits of Rating Scales

The merits of rating scales are as follows:

1) **Provide Standardisation:** The utmost importance of rating scales is that these scales are standardised in nature. These scales allow the researchers to compare the objects, attributes, beliefs, etc., in an organised way. These scales can be used both in qualitative as well as quantitative analysis.

2) **Applicable for Appraisals and Assessments:** These scales are general in nature which makes them applicable in cases of appraisals and assessments.

3) **Provides Fair Outcome:** Rating scales provide fair results in case of appraisals. The fairness and accuracy make the subjective comparisons quite easy.

4) **Simple and Comprehensible:** The reason behind the popularity of rating scales is that these scales are simple and easily understandable. These scales provide huge amount of data and allow the researchers to view and read data in a structured and comprehensible manner, which makes further decisions easier.

Demerits of Rating Scales

Rating scales have following demerits:

1) **Biasness:** Rating scales do not go beyond the researcher's point of view. The attitude of researcher and his tendency towards the responses introduce a level of biasness and create differences in ratings.

2) **Applicable to Structured Cases Only:** These scales can be applied in the cases of structured items only.

3) **Impossible to Observe the Respondents Directly:** Using these scales, it is not possible to observe the behaviour of the respondents directly. The researcher's own opinions and experiences cannot be known.

4) **Limitation in Comparability:** Minute changes in the statements can affect the scale which in turn may limit its comparability.

2.6.7. Importance of Scaling

In business or management research, scaling is very crucial for the research process. It helps in measuring and analysing attitudes of different individuals. The exact behaviour of an individual is reflected by such attitude analysis. Number of attitude measuring scales has been developed by researchers. **For example,** in order to measure the attitude of an individual about a particular tourist place, product or election candidate, i.e., if he visits, buys or votes, respectively, a suitable scale is developed.

The different facts describing the importance of scaling are as follows:

1) **Attitude Scoring:** Scaling is particularly used for attitude scoring of an individual. In scaling, with the help of an individual's responses a particular number or point is selected on given scale, which represents the attitude of that individual.

2) **Broad Application:** Different management research processes as well as scientific inventions use scaling as their crucial element. Data collection methods like interviews, observations, surveys, etc., also use scaling for attitude measurement of respondents.

3) **Hypothesis Testing:** Scaling is also functional in hypothesis testing. Without effective measure of attitudes of different respondents, it is not easy to test hypothesis about the population.

4) **Dimension Checking:** Scaling is useful in determining the dimensional aspects of different quantitative concepts or items. It helps in checking whether a particular item is single dimensional or multi-dimensional.

5) **Others**
   i) It is an essential element of the exploratory research.
   ii) It is used to check whether a set of questions is measuring single aspect or multiple aspects.

2.6.8. Issues in Designing Attitude Scales

A measuring instrument cannot fulfil all the criteria of a good measurement scale. Some of the issues that are needed to be addressed while constructing a measurement scale are as follows:

1) **Number of Points in Scale:** It has been found that beyond a point, the increase in number of statements or scale points proves to be disadvantageous. **For example**, if the scale points are increased from 3 to 10, its reliability is increased, however, if the scale points are further increased to say, 12, its reliability declines. The reason for this is the fatigue factor. Therefore, a factor to be kept in mind while designing a scale is "respondent fatigue". **For example**, a 5-point scale may be more sensitive and reliable than a 3-point scale and similarly, a 7-point scale may be better than a 5-point one. But, a 10-point scale may not be better than the 7-point one, as "respondent fatigue" sets in. People tend to get bored and want to get rid of the procedure. Similarly, the number of items in a test should be kept to the minimum. In case a large number of answers are required, the test could be split into two or more parts.

2) **Odd *versus* Even Number of Options:** Whether a scale should have odd or even number of options is an unresolved topic of debate amongst researchers. Researchers who prefer odd numbers of objects in a scale argue that odd numbers provide a mid-point or an opportunity for neutrality to a respondent who would otherwise be forced to take a stand either way. Such scale would typically read like this: –3, –2, –1, 0, +1, +2, +3.

   Those in favour of even number of options argue that there is no such thing as neutrality. According to them, an individual is never neutral and an even number scale compels him to expose or reveal his true stand or position. As such no hard evidence or proof about correctness of any stand-point has been found yet.

3) **Balanced *versus* Unbalanced Scale:** Ideally, a scale should be balanced with a mid-point, i.e., with an equal number of favourable and unfavourable responses. It determines how balanced the scale is in terms of providing an equal opportunity to people who are against a subject and people who are in favour. **For example**, a balanced scale can be formed like, "very poor – poor – average – good – very good", and an unbalanced scale can be formed like, "poor – fair – good – very good – excellent – outstanding". The later can be seen to be loaded with favourable options. It is not a balanced scale. The distribution of responses is asymmetrical and does not provide equal choice of intensity to those against the subject. However, efficiently constructed scales can be balanced with or without mid-point.

4) **Forced *versus* Unforced Scales:** This is a question of whether or not to provide an opportunity to respondents to express no opinion by providing options like "do not know", "undecided", "neutral", and so on. This actually provides ease to those who have not decided or are uncertain about the answer. When researchers know and are convinced that respondents do have an opinion, exclude such responses. On the other hand, when respondents actually do not have a response, lack of such options force them to opt for incorrect options resulting in corruption of findings. This affects the mean and median, and thereby the results get distorted. In fact, understanding and analysing neutral responses is always a challenge for researchers. Hence, responses should be judiciously chosen, depending upon the nature and scope of the test.

5) **Labelling of Response Categories:** Responses can be verbal, numerical or even pictorial, depending upon the requirements of the test as well as the profile of the respondents. The next issue to decide is whether to label all the responses or not. Some researchers tend to label only the extreme responses while some prefer to label all of them. While there is no evidence or proof to establish that either of the methods increases accuracy, it is generally accepted that descriptions should be as close as possible to the responses. It is finally left to the skills of the researcher to decide on the 'labelling' process.

2.7. EXERCISE

2.7.1. Short Answer Type Questions

1) Explain the features of good research design.
2) Define depth interview.
3) Where can case study technique be applied?
4) Define the informal research design.
5) Where experimental research design can be applied?
6) Define observational method.
7) What are the limitations of descriptive research design?
8) Define the term research variable.
9) What do you mean by attitude scales?
10) Where nominal scale can be applied?
11) How reliability of instruments can be judged?

2.7.2. Long Answer Type Questions

1) What do you mean by research design? What are the factors that affect the research design?
2) Give the significance of research design. Also enumerate the process associated with research design.
3) Explain exploratory research design. What are the different methods of exploratory research?
4) Highlight the applications of exploratory research.
5) What is descriptive research design? State its significance.
6) Illustrate criteria for causality in experimental research design. What are the basic principles of experimental design?
7) What are the significance and limitations of experimental research?
8) How the validity of research can be judged? Explain.
9) What do you mean by variables in research? Give different types of research variable.
10) Elucidate the term 'measurement' in research? Also enumerate the measurement process.
11) What do you mean by scaling? State process of construction of instrument.
12) Illustrate the different scaling techniques used in research. Give the issues in designing attitude scale.
13) Write short notes on:
    i) Validity of instrument
    ii) Reliability of instrument

UNIT 3

Collection of Data

3.1. DATA COLLECTION

3.1.1. Introduction

Data is regarded as the foundation of all types of research, and hence it is known as **"Life Blood of Research"**. Any research cannot be completed without proper collection and analysis of data. In order to understand the problem underlying research accurately and designing the feasible solution for that problem, quality data is needed. Hence, data collection is crucial to analytically understand the problems and for obtaining the solutions for it. Conducting research based on old and irrelevant data may result into useless and faulty solutions for a particular problem.

Data collection is done with a purpose of gathering information about the topic being studied by the researcher. It is a process of finding appropriate sources of information and compiling the information to reach a particular solution. It helps the managers in recording, analysing, and making decisions regarding significant issues. Data collection starts with identifying the purpose of research, following the identification of the sources and methods of data collection, collecting the data, and ends with analysing the collected data to reach at the conclusion or solution of the research problem.

A research can be carried-out with the help of two types of data, *viz.*, **primary data** and **secondary data**. The former can be defined as the data which is collected for the first time by the researcher, while the later can be defined as the data which are already collected and statistically processed for a particular event or problem. Secondary data are indirectly based on primary data or are directly calculated from the primary data.

3.1.2. Methods of Collecting Data

Depending upon the sources being utilised, any statistical data can be divided into two categories, which are as follows:

1) **Primary Data:** The data which is directly collected by the researcher and was not available before is called as "primary data". The sources of primary data are very useful in finding the real facts about the incidents or events. It includes the personal observation of the researcher and respondent. Primary data are the freshly collected data that provide information about a particular problem. These data can be gathered using techniques like, interview, observation, mailing, counselling, etc.

2) **Secondary Data:** The previously recorded information about an event is very important in finding the solution of similar kind of problems. This readily available information is called "secondary data". It is already processed and compiled with an evaluation. These can be gathered from the published reports like census reports, annual reports, financial assessment reports, and journals, as well as from unpublished sources. Various statements and records about the performance of a particular organisation and its departments like accounting records, minutes of meetings, inventory records, etc., fall in the category of secondary data sources.

3.1.3. Precautions in Collection of Data

Following guidelines which are based on various data collection sources should be considered while collecting data:

1) **Primary Data:** It is a very difficult task to collect the necessary information. Also, it is difficult to collect data from the field situation in comparison to the data collected from the organisational situation. Various precautions which a researcher must observe to collect definite, unbiased and accurate information from

field, and to overcome the difficulties like lack of cooperation, inaccurate information and stress are as follows:

i) **Friendly Attitude:** Interviewer should collect the information in a friendly manner and is presumed to be polite and disciplined. He should be focused towards creating and maintaining a good relationship with the respondents. The respondents should be acknowledged regarding their cooperation in the research work.

ii) **Appropriate Use of Words:** The words and sentences must be proper and known to the respondents. Moreover, it should not hurt the emotions of respondents. Interviewer should replace the unfamiliar words with more suitable and familiar words so as to provide convenience to the respondents in understanding the questions.

iii) **Avoiding Objectionable or Unsuitable Questions:** Interviewer must avoid socially objectionable questions. But, if it is necessary, then he must use indirect questions for the objective.

iv) **Transparency to the Respondents:** The researcher should always maintain the transparency with the respondents. He should clearly communicate the objective of research and fieldwork. At times, respondents are reluctant to answer the questions if research objectives are not explained clearly.

v) **Confidentiality and Privacy of Respondents' Identity:** The researcher should make sure to the respondents that adequate privacy and confidentiality measures have been adopted during the collection of data.

2) **Secondary Data:** Similar to the primary data collection, there are some precautions that are needed to be taken during secondary data collection. Some of those precautions are described below:

i) **Objective of the Study:** While collecting the secondary data, whether internal or external, the researcher should keep in mind that the data collected should be relevant with the objective of research. Also, the researcher should check the authenticity, accuracy and compatibility of the secondary data based on the objective of study, as it gives the idea of research procedures, research design, types of data used, etc. Hence, the researcher should focus on the objective of study and must collect the data accordingly, by using specific techniques.

ii) **Reputation of Data Sources:** While collecting data from secondary sources, it should always be kept in mind that the quality of data differs vastly among the available data sources. Some sources contain credible, valid and accurate data as their sole emphasis is on quality work. While, on the other hand, other sources may contain inaccurate and false data that may disturb the analytical process and thereby provide inaccurate outcomes. The researcher should wisely select the reputed sources of data.

iii) **Context of the Data:** The researcher should filter-out the available secondary data, as only some part of the data can be applicable on the research for accuracy and precision. Hence, the secondary data should match with the objectives of research.

For example, if a research problem is associated with niche marketing, then secondary data on the core marketing concepts will not be applicable. Therefore, the researcher needs to collect data which is specific to the topic.

iv) **Time of Information:** The time at which the data has been collected, influences the research outcome in a significant way. The time factor can also affect the measures and their definitions.

For example, if the researcher has the research study on weather reports, then the time of the readings is vital; also if the research is done on the amount of traffic for a particular city, then alongwith the other factors, time of data collection is also significant as the amount of traffic in a particular area varies with time.

v) **Methodology Implemented:** The researcher should possess the knowledge of research methodology implemented during the process of data collection, so as to evaluate the quality of secondary data. He should have an in-depth knowledge about research design, sample size, response rates, questionnaires, schedules, interview procedures and other analytical techniques involved in the research study in order to examine the compatibility of the secondary data as per the research study.

3.2. PRIMARY DATA

3.2.1. Introduction

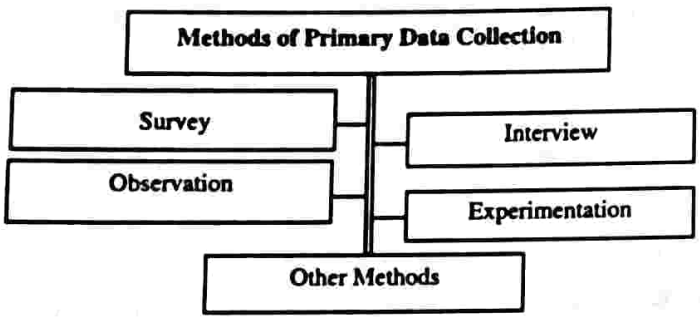
The data collected by the researcher himself for finding the solution of a particular problem or situation, is known as primary data. This type of data is characterised by its originality as it is freshly collected. Various organisations conduct surveys, observations, interviews, etc. and as a result generate primary data. Although secondary data provides a basic understanding to the research problems, but sometime, it becomes necessary to collect primary data as the previously generated secondary data may not serve the purpose.

Just like secondary data, researchers should also take additional care while collecting primary data such that it is accurate, reliable, and unbiased. For collecting primary data, researchers need to take many decisions regarding proper selection of relevant sources, sampling techniques, research tools, etc.

To conduct any research effectively and produce valid results, researchers should collect primary data as it contains current and exact information about the incident or event. One of the major benefits of primary data is that its validity and reliability can be verified by other experts. There are many ways to collect primary data such as observation, interviews, group discussions, case studies, etc.

3.2.2. Methods of Primary Data Collection

Major methods for collecting primary data are as follows:



1) **Survey:** This technique is one of the most common and widely used techniques for collecting primary data. Survey can be conducted using various methods such as using mails, telephones, internet, face-to-face, etc. The selection of survey method relies upon various factors such as the nature of population to be studied, size of sample, allotted time, allocated budget, etc.

2) **Interview:** Interview is the exchange of ideas which takes place between two or more people with the purpose of getting information from the respondent. In this method, the interviewer organises a meeting with the respondent regarding an object or issue related to the research objective, and asks some questions. The responses of the interviewee are recorded and compiled to get a better insight into the research problem. Interview can be conducted through various methods such as personal interview, telephonic interview, mail interview, panel interview, etc.

3) **Observation:** Another technique for gathering primary data is observation. When the researcher records information about a person, organisation, or situation, without making any personal contact, it is known as "observation method". In this, the researcher or the field executive observes the activity of the concerned person or organisation, to draw a pattern of behaviour or response to a particular incident. Sometimes, an artificial environment is created to collect the actual responses of the participants.

4) **Experimentation:** An important method to collect primary data is experimentation. In experimentation, the causal relationship is determined and analysed between variables. Experimentation is carried-out with the objective to study effect on a dependent variable by causing a change in the independent variable. **For example,** a research can be conducted to analyse the influence on learning due to guidelines and instructions in schools.

5) **Other Methods:** Other methods for collection of data are described below:
   i) **Warranty Cards:** Warranty cards are generally used by the dealers of consumer durables to get the feedback of products from their consumers. These are the postal sized cards placed within the package

of product. These cards contain various questions regarding the performance of product and to know the needs of consumers. Customers are requested to fill and mail it back. It helps in new product development for the manufacturer.

ii) **Auditing:** Auditing is a technique for assessing the performance and current position of any department or the organisation. Sometimes, it is also used for understanding the market and buying behaviour of customers. Distributors or manufacturers use this tool for gaining the competitive advantage and satisfying the need of customers. It is also used by the researchers for inspecting the products, services or food purchased by consumers, also known as pantry audit.

iii) **Simulation:** Simulation is a quantitative technique for data collection. It is the creation of an artificial environment resembling a real life situation. This real life situation is simulated by using various mathematical equations and variables. Researchers can determine the relation between different variables by altering one of the variables and finding its effect on the others.

3.2.3. Significance of Primary Data

Primary data is significant in research due to following reasons:

1) **Reliability:** As the primary data is collected originally by the researcher and it is current and accurate, it is more reliable than secondary data.

2) **Variety of Techniques:** Primary data can be collected through various techniques. There are numerous tools and techniques available to record and analyse primary data such as interviews, questionnaires, observation, audits, etc. It allows the researchers to explore effectively in almost every area where research is possible.

3) **Wide Coverage Including Special Cases:** Primary data is applicable in many areas including some special cases. Sometimes, researchers want information regarding particular cases for which previous literature is not available. Collecting primary data is the only solution for these specific research problems or issues. In these cases, primary data is the only source of information which can be trusted for effective solution.

4) **Complete Control over Process:** Sometimes, organisations ask the researchers to conduct the research in specific area rather than in broader perspective. Collecting the primary data allows the researchers to collect the data of their concern and represent it in ways that can benefit the organisations. Researchers can also decide the length of study, location in which research is to be carried out, time duration, etc., as per their requirement and convenience.

5) **Cost Effective Collection:** The collection of primary data is cost-effective. Many times unnecessary time and money is wasted in collecting secondary data, and the information proves to be useless. But in primary data collection, the researcher concentrates his efforts on potential sources of data which provide reliable information in optimal cost.

5) **Sole Ownership of Information:** As the information processed from the primary data is fresh and original, it can be copyrighted. This way, the researcher becomes the owner of that information. He/she can take the benefit of information by sharing it with organisations. This is not so in the case of secondary data, as it already belongs to other person or organisation.

3.2.4. Limitations of Primary Data

Primary data has following limitations:

) **Costly Affair:** Primary data collection is an expensive task. It involves different activities like selecting type of technique, preparing questions, and hiring trained professionals for collecting information or observing targets, etc. In this process, a huge amount is spent, which is why it is costly to conduct.

) **Time Consuming:** Collecting primary data effectively takes more time. Developing research plan, deciding sources of information, and selecting the methods of data collection are time consuming activities.

) **Infeasible Sometime:** Although, primary data considered to be reliable source of information, but, sometimes it is not an easy task to collect the primary data, as the sources of information may not be in the reach of researcher or may incur a huge amount of money.

4) **Huge Quantity of Data:** Sometimes data collected through primary sources are in huge quantity. This large volume of data leads to confusion about the accuracy of the information. The processing and analysis of the data becomes complex and cumbersome due to large size.

5) **Unwillingness to Answer:** Sometimes, participants do not cooperate in data collection by showing unwillingness to answer or by giving wrong information. These factors act as hurdles in primary data collection and also reflect biasness in responses.

3.2.5. Tools for Collecting Primary Data

The two main primary data collection tools are as follows:

1) **Questionnaire:** A questionnaire is a list of questions arranged in a specified manner in order to enquire regarding a particular subject. The researcher deliberately designs the questionnaire so that the information needed can be easily extracted from the respondents. In order to identify and outline any mistake in the questionnaire, a pilot study is conducted among a small sample with the help of a rough draft. This in turn helps the researcher in modifying the questionnaire, when necessary.

2) **Schedule:** Schedules are widely used in primary data collection. Schedules consist of a list of items on which the needed information is to be collected. The responses are obtained from the respondents. Hence, enquiring the respondents and extracting meaningful responses is the sole responsibility of the interviewer.

3.3. QUESTIONNAIRE

3.3.1. Introduction

Questionnaire is a method of primary data collection that comprises of different sets of questions to get information from the respondents for the problem identified by the researcher. It is an orderly arrangement of questions that helps in generating the required primary data which can then be analysed and interpreted to solve a research problem. Using questionnaires, the researchers can ask direct questions to a number of people.

Questionnaire helps the researchers in decision-making on various issues. The response obtained from the questionnaire can be analysed quantitatively. The respondents of a questionnaire need no assistance of the researcher to fill the form, unlike in schedule where the researchers fill the form. A questionnaire can be administered orally, telephonically, via the web, etc.

The success of a questionnaire depends on the skills of researcher in framing it appropriately. It requires in-depth knowledge, experience, and a lot of patience on the part of researcher to administer a questionnaire properly. The designing of a questionnaire is one of the most important aspects for proper data collection. Hence, researchers should frame the questionnaire in such a way that they need not to recollect the data, as there would be a single chance to interact with a respondent.

3.3.2. Type of Questions

Type of questions to be used in a questionnaire depends upon the type of information required. A questionnaire can consist of many types of questions. Major types of questions are as follows:

1) **Open-Ended Questions:** Open-ended questions contain no pre-set options or scales. These questions are asked when the researcher does not want to limit the answers of a respondent. Here, the researcher wants the respondents to give insightful and real answers as well as suggestions for the problem being investigated. The type of analysis will be qualitative in nature as coding the responses of the respondent will be a difficult task for the researcher. Every sound questionnaire contains open ended questions. **For example**, if in a questionnaire a question, "What do you think of the IPL's marketing strategy?", is asked, the responses to this question will vary from person-to-person and will be difficult for the researcher to predict.

2) **Closed-Ended Questions:** When the questions are to be answered within a boundary of limited options, indicators or scales, they are called as "close-ended questions". These are the opposite of open-ended questions. The number of these choices or measures may be even or odd. Since the answers from the

respondents fall into definite categories, it becomes easy for the researchers to undertake quantitative analysis on these types of questions. These types of questions can be asked to variety of people at different times and sufficient amount of responses can be gained. **For example**, a researcher can ask following question:
"Who will win the IPL this year?"

i) KKR
ii) Kings XI Punjab
iii) Chennai Super Kings
iv) RCB

Close ended questions are of following types:

i) **Leading Questions:** When the close ended questions are asked with slightly similar options or measures like 'good', 'great', 'best', 'excellent', etc., they are called "leading questions". These questions are framed in such a manner so as to elicit a predictable response from the respondent. Such questions are used to identify the preferences of customers. Typically in questionnaire design such questions should be avoided as they affect the unbiased nature of the questionnaire. **For example**, how was the service of this restaurant?

a) Excellent
b) Good
c) Average
d) Below Average

ii) **Likert Questions:** These questions are based on the Likert scale. Likert questions carry five or seven levels of expression, which act as scales, describing the level of agreement or disagreement over a particular issue or statement. **For example**, a Likert question can be, "Do you agree that India is likely to replace the USA as a global economy by the year 2020?" , its responses can be categorised like:

a) Strongly agree
b) Agree
c) Neither agree nor disagree
d) Disagree
e) Strongly Disagree.

Likert questions provide the responses that can be quantitatively analysed and are often used in psychometric profiling

iii) **Dichotomous Questions:** Questions asking respondents to answer by selecting one of the two options, such as 'A' or 'B', 'agree' or 'disagree', 'true' or 'false', 'yes' or 'no', etc., are called "dichotomous questions". A limiting factor in the efficiency of dichotomous questions is that, it cannot record the opinions that vary between the two ultimate options. An example of dichotomous question can be "Do you smoke?", and the respondents need to choose between "Yes" and "No". These questions are useful for those questions that have definite answers such as mentioning the "gender" as "male" or "female".

iv) **Bipolar Questions:** Questions having scale with two extreme responses are called bipolar questions. The respondent is required to select his/her response between the two opposite choices of the scale. **For example**, how do you rate the food of Café Coffee Day?

a) Excellent
b) Good
c) Average
d) Poor

Here the adjectives 'excellent' and 'poor' are actually opposites of each other and hence are bipolar in nature.

v) **Rating Scale Questions:** When the respondent is required to rate a particular product, issue, organisation, or feature, etc., using scales ranging from poor to good, it is called "rating scale questions". These are based on rating scales which can be both odd numbered, or even numbered though even numbered rating scales are used more. **For example**, rating a movie in terms from 1 to 5 stars with 1 being the lowest and 5 the highest.

3.3.3. Types of Questionnaire

A questionnaire can be either structured or unstructured, and both of these can be either disguised or non-disguised in nature. A questionnaire is structured when it follows a particular format of asking questions, whereas in an unstructured questionnaire, the researcher does not have to follow any pattern in administering the questionnaire. In a disguised questionnaire, the purpose of the research is kept hidden from the respondent, while in non-disguised questionnaire, the objective of the research is known to respondent in advance. Hence, in this way, questionnaire can be of following four types:

1) **Structured, Non-disguised Questionnaire:** This type of questionnaire contains pre-arranged sets of questions which are asked strictly in a fixed format. The objective or the purpose of this questionnaire is

already explained to the respondents because by doing so that they can realise the importance and provide desired response. The respondents are required to answer the questions in the sequence in which questions are to be asked, the answers of which are provided in specified alternatives. This type of questionnaire is very popular among market researchers. **For example**, if the sales manager of a four-wheeler automobile company wants to know the buying preferences of consumers, a formal set of structured questions is necessary to design. It will help in finding required information from masses. It may include following sequential questions:

i) Do you own a four-wheeler? Yes____ No____
ii) If yes, which brand? Maruti ____ Tata____ Hyundai____ Toyota_____
iii) Which fuel does it run on? Petrol_____ Diesel____ LPG_____ CNG_____
iv) What is the best feature of your car? Fuel Efficiency ____ Comfort____ Space_____ Safety____

There are three basic methods to administer structured, non-disguised questionnaires, which are, personal interview, mailing, and telephone. Limitations of this kind of questionnaires include inability of respondents in providing the desired information, unwillingness of respondents, and the ineffectiveness of questions in deriving correct responses.

2) **Non-structured, Non-disguised Questionnaire:** A non-structured, non-disguised questionnaire contains open-ended questions, which are not like structured, non-disguised questionnaires. Here, the objective of the study is made clear at the beginning itself so that the respondent is aware of the purpose of his answers to be used in research. Open-ended questions facilitate the respondents to talk about his experiences, opinions and viewpoints. Since, these are unstructured in nature, deciding the sequence of asking questions entirely depends upon the researcher. **For example**, how do you feel about 'Section-377' of the Indian Penal Code that criminalises sexual activities that are against the order of nature? Now, the further questions would depend on the answers of respondents. This kind of interview is called 'depth interview'.

   The benefit of this kind of questionnaire is that large amount of information may be collected as the researcher is free to change the sequence of questions as needed. Only desired information is gathered through this questionnaire. This questionnaire also suffers from several limitations. It consumes more time to administer and sometimes there may be non-cooperation from the respondents, and thus quantification of open-ended responses becomes difficult.

3) **Non-structured, Disguised Questionnaire:** As the name reflects, non-structured, disguised questionnaire is one in which, questions are not pre-arranged and the purpose of interview is not revealed to the respondent to obtain their original and unbiased reactions. The idea here is that respondents would show their attitudes without hesitation which would not be reflected when the purpose is known. Here, the interviews take the form of word association tests, storytelling, sentence completion tests, etc.

4) **Structured, Disguised Questionnaire:** In this type of questionnaire, the researcher does not reveal the purpose of the study but still retains a structured manner of research. Here the researcher tries to expose the latent perceptions of respondents through use of psychometric scales. This questionnaire is used in case of inability of non-disguised questionnaire. Through this method, the information known by the respondent is explored, rather than their feelings about an object or an issue. **For example**, "What do you think about the 9/11 attacks?"

3.3.4. Construction of Questionnaire and Instrument

A questionnaire is a systematic way of getting primary data. In other words there is a process of designing a questionnaire, failing which, the objective of research will not be met. The steps involved in designing the questionnaire are as follows:

1) **Determine the Need of Information:** Before designing the questionnaire, the researcher needs to be clear on what information is needed to answer the research objectives. In this step, the researcher prepares a statement highlighting the information required to be collected so that it can serve the purpose of research. Once, the researcher knows the type of information needed, he/she can easily select the type of questionnaire to be prepared for research. **For example**, if the researcher's objective is to understand the brand image of a particular mobile phone then he needs to gather information on whether the brand is fulfilling all aspects that a consumer seeks in a mobile phone, i.e., price, features, distribution, service, etc.

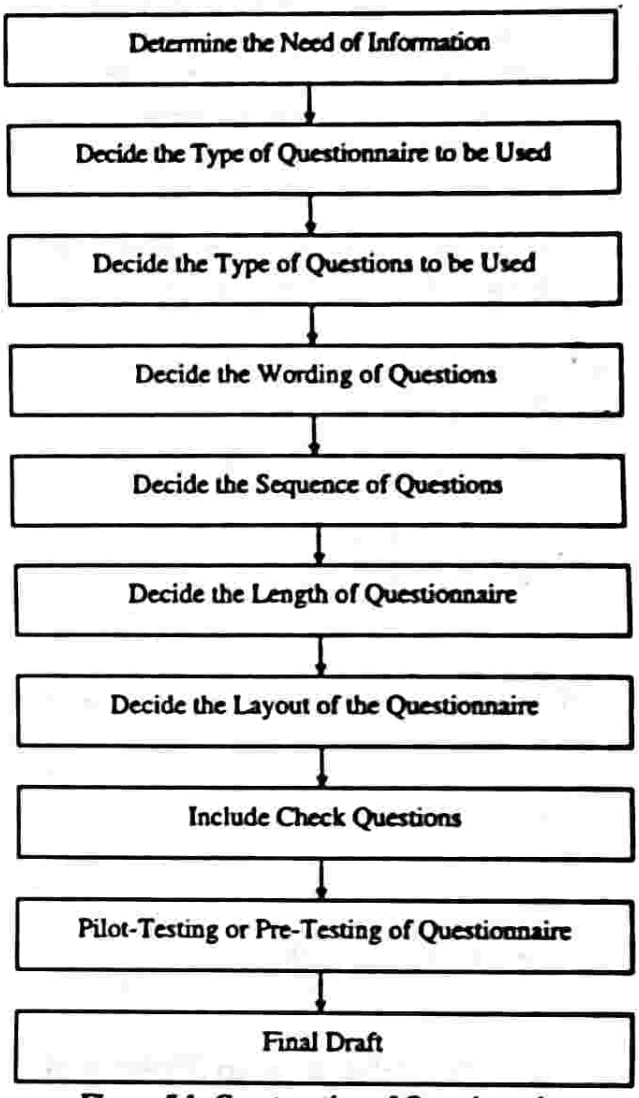

Determine the Need of Information
Decide the Type of Questionnaire to be Used
Decide the Type of Questions to be Used
Decide the Wording of Questions
Decide the Sequence of Questions
Decide the Length of Questionnaire
Decide the Layout of the Questionnaire
Include Check Questions
Pilot-Testing or Pre-Testing of Questionnaire
Final Draft

Figure 5.1: Construction of Questionnaire

:) **Decide the Type of Questionnaire to be Used:** Once the information need is addressed, the researcher next needs to find out the type of questionnaire to be used. There are basically four types of questionnaires available for research, which are structured-non-disguised questionnaire, non-structured-non-disguised questionnaire, non-structured-disguised questionnaire, and structured-disguised questionnaire. Each one of these has different format and representation, and is used in different situations. Researcher can select the type of questionnaire suitable for current research problem. This phase also emphasises on getting to know the means for administering the questionnaire, such as telephone, mail, face-to-face interview, etc. The selection of 'type of method' depends on the type of information required as well as the type of respondents to be approached. If the questionnaire is disguised and unstructured, the researcher has to select face-to-face conversation. On the other hand, if the research objective allows a mass questionnaire and doesn't involve customisation then the researcher can resort to telephonic or mail methods.

3) **Decide the Type of Questions to be Used:** After selecting the types of questionnaire to be used for collecting data, the next step is to determine the content of each question. It is very critical for the researcher as it encourage the respondent to give their genuine responses. The type of questions to be used generally depends on the type of questionnaire to be used as well as the purpose of research. **For example**, if the research purpose is to know the opinion of people regarding gender biasness, and the questionnaire is unstructured and disguised, the questions should be such as:

i) Do you have brother or sister? Yes____ No____

ii) If yes, then how many? No. of brothers_____ No. of sisters_____

iii) In which kind of school have you completed your education? Co-ed_____ Girls/Boys school____

4) **Decide the Wording of Questions:** As the type of questions to be used in questionnaire is determined, researcher now concentrates on the wording and phrasing of the questions. The questions should be very simple and unambiguous. No confusing or sentimental words should be used. Easier the words are used, more it becomes effective. Any inappropriate word or phrase may hinder the relevant answers of the respondents. The wording of a questionnaire should be framed keeping in mind important factors like, language, education, research purpose, etc. **For example**, if the target segment comprises uneducated/low educated respondents, then a questionnaire which is full of research jargons will fail.

5) **Decide the Sequence of Questions:** After finalising the wording or phrasing of the questions, next step is arranging the questions in most appropriate and effective way. A questionnaire has many parts – basic data, classification data and identification data. There should be a flow in which the questions should be asked. The sequence of questions is very important for a questionnaire to be effective. Hence, significant efforts should be put by the researchers in arranging the questions in an order that can prove to be helpful in getting the responses.

5) **Decide the Length of Questionnaire:** The next step in designing the questionnaire is to determine the length of questionnaire. It is one of most critical aspects of an effective questionnaire design. If the questionnaire is very long, then the respondent will lose enthusiasm in answering the questions. Similarly, if the questionnaire is too short, then the required data for the research will not be gathered from the

questionnaire, and the researcher will not be able to conclude the research properly. It is very important that the respondent feels engaged while giving his answers. The ideal time for a questionnaire ranges between 30 to 40 minutes which can be extended up to 60 minutes for face-to-face interviews. One important factor to keep in mind is the respondent. How long can they be available for filling up the questionnaire? Will they be interested in the questionnaire? , etc., are some of the important questions that a researcher should answer himself before framing the questionnaire.

7) **Decide the Layout of the Questionnaire:** After finalising the length, the layout and reproduction of questionnaire is determined keeping in mind its effectiveness. The look, feel, and the layout of the questionnaire also matters. Respondents also hesitate to answer when they find the questionnaire cluttered and cumbersome. Hence, it is essential for the researcher to keep in mind that the questionnaire should be well printed, should be easy to understand by the respondents, and should be of adequate length. All these factors are necessary not just for helping the researcher and respondents in filling the questionnaire but also in analysing the answers given by the respondents.

8) **Include Check Questions:** Sometimes respondents answer differently for the same issue, which in turn can be difficult to analyse and can produce errors in results. This problem can be eradicated by including some check questions in the questionnaire. These questions help in verifying the reliability of answers and in comparing the responses from other sources.

9) **Pilot-Testing or Pre-Testing of Questionnaire:** It is impossible to design a perfect questionnaire in one trial that is why there is a step called "pilot-testing" or "pre-testing", which can show the shortcomings of the questionnaire. In this, the questionnaire is tested on a smaller sample size in simulated conditions identical to actual. Administering questionnaire is a costly affair as it needs significant time and money. Therefore, with the help of pilot-testing, the flaws in a questionnaire can be addressed and rectified before the actual survey is undertaken. The pre-tests are continued in loops till there is no error left.

10) **Final Draft:** Once the pilot tests are completed and all the corrections required in the questionnaire have been incorporated, the final draft of the questionnaire is ready to be implemented.

3.3.5. Precautions in Preparing Questionnaire

Precautions for preparation of questionnaires are as follows:

1) **Arrangement of Questions should be Logical:** The flow of questions in a questionnaire should be logical and follow a smooth pattern. Ideally, it should be arranged like a flowchart to avoid haphazard questions. Every question in the questionnaire should have a purpose. Mismanaged sequence of questions can lead to confusion among the respondents.

2) **Numbering of Questions:** For making the questionnaire easy to operate, the questions should be numbered. The serially numbered questions make it effective and adjustable. The researcher can adjust the sequences of the questions as per the situation.

3) **Questions should Require Recent and Remembered Data:** It is not advisable to include questions may force too old incidents or questions which demand complicated data, as it may force the respondent to either guess the answer or quit the survey. Include only those questions which require recent and easily remembered data. Questions that unnecessarily make the respondents to think too much about the past should be avoided as these may cause inaccurate outcomes.

4) **Avoid Vague Questions:** The researcher should refrain from asking vague questions. The wording of the questions should not be ambiguous. Ambiguous words or sentences may lead to misinterpretation by the respondents and the response may be altered. The questions should be specific enough so that respondents understand it easily. **For example,** "how do you rate your car?" is a vague question because a car can be rated on many features like looks, performance, durability, fuel efficiency, etc. A question like this can make the respondent feel confused as he or she does not know on what attribute the rating is to be given.

5) **Avoid Leading Questions:** A researcher should avoid including the leading questions as these questions bind the respondents within a specific options. They are unable to express their real feelings or thoughts freely. **For example,** "Do you own a Santro car?" is a leading question, which can be asked as "Which brand of car do you have?".

6) **Avoid Personal Questions:** For an effective survey and valid responses, asking personal questions should be avoided. There are some demographic variables which respondents often do not answer truthfully. **For example**, "What is your monthly income?" it is a direct question, which most of the time, are avoided by the respondents. But if such information is vital for the research, it can be asked by providing range of income like 0-5000, 5001-10000, 10,001-15000, 15,001-20000, 20,001-25000, 25,001 and above.

7) **Good Transition between Questions:** Good transition between questions is very vital for the flow of questionnaire. The successive questions should have a recognisable link, so that the respondents can understand the questions and hence, answer correctly.

8) **Avoid Skip-and-Jump Questions:** These are the questions where the respondent is asked to select between two choices, and subsequent questions are related with both the choices. The respondent has to attempt only the applicable questions. These questions make the respondent skip and jump sections too often and distract them. These questions are very confusing for an average respondent and also take much time, therefore these questions should be avoided.

9) **Quality of the Questionnaire:** The questionnaire should have a proper layout and look. It should be printed on proper paper with appropriate colour. The questions should be correctly typed in proper font type and size. It attracts the respondents and helps in finding genuine responses. Researchers should try to maintain the confidentiality of respondents' identities. This will help in gaining their trust as well as reduce biasness of results.

10) **Questionnaire should be Easy to Handle:** For effective collection of relevant responses of individuals, it is very necessary to keep in mind that the questionnaire should be easy to handle by the respondents as well as the researcher. The more the questionnaire is prepared with caution, the more it is easy to handle. For this, only limited questions should be provided in the questionnaire to derive the information needed. Questionnaire overloaded with queries make it confusing and hence creates difficulties in its difficulties.

3.3.6. Validity/Validation of Questionnaire

Validity is the most critical criterion and indicates the degree to which a questionnaire measures what it is supposed to measure. Validity can also be thought of as utility. In others words, validity is the extent to which differences found with a measuring instrument reflect true differences among those being tested.

It is the extent to which a test measures what researcher actually wishes to measure. The ability of a scale or a measuring instrument to measure what it is intended to measure can be termed as the validity of the measurement. **For example,** students may complain about the validity of an exam, stating that it did not measure their understanding of the topic, but only their memorising ability. Another example may be of a researcher who tries to measure the morale of employees based on their absenteeism alone; in this case too, the validity of the research may be questioned, as absenteeism cannot be purely attributed to low morale, but also to other conditions like prolonged illness, family reasons and so on. Validity can be measured through several methods like:

1) **Face Validity:** Face validity is perhaps the simplest of the four types of validity. Face validity can refer to a single item or to all of the items on a test, and it indicates how well the item reveals the purpose or the meaning of the test item or the test itself. **For example,** the test item "Recently I have thought of killing myself" has obvious face validity as an item measuring suicidal ideation. The downside of items on tests with clear face validity is that they are more subject to being manipulated by respondents, either to deny or hide problems or to malinger or exaggerate problems. Some psychometricians like tests that lack face validity but still possess general validity. Tests or items that still measure what they purport to measure but lack face validity are harder for respondents to manipulate. **For example,** the item "I believe in the second coming of Christ" appeared on the first version of the MMPI and loaded on the depression scale. Because most of the people in the original normative sample of the MMPI were good Christians, only a depressed Christian would think Christ was not coming back. Obviously, this question would not be a good one for people of many other faiths and beliefs. Thus, although a lack of face validity may have some attractive features, items that have some face validity may, in the long run, make for a better test.

2) **Content Validity:** Content validity refers to the adequacy in the selection of relevant variables for measurement. The scale that is selected should have the required number of variables for measurement. **For example,** if the state education department wants to measure whether all the schools in the city have adequate facilities, and for measuring this, it develops a scale to measure the attributes like the attractiveness of schools, names, the frequency of old students meets, the different varieties of eatables that

are prepared in the school canteen and so on. Here, it is clear that these variables considered for measurement do not possess any content validity as they will not serve the purpose of the research. The scale should instead be developed to measure aspects such as the number of classrooms. The number of qualified teachers on the roll, the capacity of the playground and so on. It is often difficult to identify and include all the relevant variables that need to be studied for any research process.

3) **Criterion Related Validity:** Criterion validity reflects whether a scale performs as expected in relation to other variables selected as meaningful criteria (criterion variables). Criterion variables may include demographic and psychographic characteristics, attitudinal and behavioural measures, or scores obtained from other scales. Based on the time period involved, criterion validity can take two forms:
   i) **Concurrent Validity:** Concurrent validity is assessed when the data on the scale being evaluated and on the criterion variables are collected at the same time. To assess concurrent validity, a researcher may develop short forms of standard personality instruments. The original instruments and the short versions would be administered simultaneously to a group of respondents and the results compared.
   ii) **Predictive Validity:** To assess predictive validity, the researcher collects data on the scale at one point in time and data on the criterion variables at a future time.

4) **Construct Validity:** Construct validity addresses the question of what construct or characteristic the scale is in fact, measuring. When assessing construct validity, the researcher attempts to answer theoretical questions about why the scale works and what deductions can be made concerning the underlying theory. Construct validity is the most sophisticated and difficult type of validity to establish. Construct validity includes:
   i) **Convergent Validity:** Convergent validity examines the degree "to which two or more attempts to measure the same concept through maximally dissimilar methods are in agreement" and thus the potential of shared systematic error (e.g., method variance). It is therefore, evident that both convergent validity should involve different measures of one construct in order to identify whether they really measure the same thing and that both "can be seen as regions on a continuum". The difference is that "reliability is the agreement between two efforts to measure the same trait through maximally similar methods". While convergent validity focuses on maximally different methods. While internal consistency analyses whether all indicators share some kind of communality, convergent validity tests whether this communality is due to same underlying construct they are intended to measure, or is based on the same method which was used to measure them. Therefore, it is obvious that it does only makes sense to test for convergent validity if a set of indicators shows a sufficiently high level of internal consistency.
   ii) **Discriminant Validity:** In contrast to congruent validity, discriminant validity refers to the extent to which a test score does not correlate with the scores of theoretically unrelated measures. Let us return to the problem of designing a creativity test. It is important to show that the test measures only creativity and not something that resembles creativity, such as intelligence. To establish discriminant validity, one might give both the creativity test and a standard intelligence test a group of people. If scores from the two tests are highly correlated, someone could argue that your creativity test does not measure creativity at all, but simply intelligence. If the correlation between the two tests is low, one has evidendce that the two tests measure different constructs. Notice that a low correlation does not tell what the test measures, but only what it does not measure. Nonetheless, this is an important step in establishing the construct validity of the test.
   iii) **Nomological Validity:** Nomological validity or criterion validity is concerned with the 'behaviour' of the construct, or in other words, how well it is related to other theoretically related constructs. Nomological validity of reflective constructs is assessed by testing the pre-specified hypotheses in the research model between the construct of interest and other constructs. When satisfactory support is found for the hypotheses, nomologically validity of the constructs is achieved.

3.3.7. Significance of Questionnaire

Significance of questionnaire is as follows:

1) **Easy to Design and Interpret:** The questionnaire is a tool which is used for quick data collection and analysis. It is easy to design and interpret. Respondents can easily understand the questions and give their genuine responses. Once the objective of research is clear, it takes less time to design a particular questionnaire. For researchers, coding and analysing the responses become easy, as every participant is asked the same set of questions, which makes it a consistent technique.

2) **Accessible to a Large Population:** The researcher is able to reach a large number of people easily through a questionnaire. Using mail questionnaire, one can have the responses of geographically dispersed individuals in a cost effective way. **For example,** internet is a very useful medium for companies to get online feedback of users about their products and services.

3) **Free from Bias:** Since the questionnaire is mostly self-administered it frees the study from any biasness that the researcher could have. Unlike the face to face interviews, here the researcher does not usually interrupt during filling of questionnaire by the respondents. Hence, researcher cannot alter the responses, which in turn reduces personal biases. This results in genuine responses and valid outcomes.

4) **Sufficient Time for Respondents to Answer:** Questionnaire provides sufficient time to think and reply. It is given to the respondent to fill it at his or her convenient time, with full attention. Respondents can also change their answers on recalling facts.

5) **Maintains Secrecy:** Many times the subject matter of the research is such that it is of a very sensitive or personal nature. In these cases a self-administered questionnaire is very useful as it allows the respondent to give his views and still maintain his secrecy. Since, respondents are not afraid of being identified or highlighted, so they honestly answer the questions.

6) **Ease in Data Compilation and Analysis:** The questionnaire provides very convenient and easy to compile information to the researchers. The data recorded with the help of questionnaires are usually structured and in simple format. Hence, the data can easily be analysed, compared, and compiled in charts, tables or graphs.

3.3.8. Limitations of Questionnaire

Besides significance, questionnaires have following limitations:

1) **Complicated Questions:** Generally, respondents easily understand the questions and give their responses very comfortably, but sometimes questions become complex in order to gain the specific information from the individuals. Complicated questions are very difficult to be self-administered as the respondent is often confused and requires personal attention of researcher while filling/answering the questions. This is practically not possible every time.

2) **Suitability of Respondents:** It is very difficult for the researcher to control the administration of the exercise. It is also possible that the questionnaire is not filled by the intended individual or institution and delegated to someone else. Many times, it is filled by an inappropriate respondent, which causes incorrect data collection. Therefore, there is no control over who fill the questionnaire.

3) **Possibility of Invalid Responses:** The questionnaire is a one-time data collection process. Once the respondent has given his answers, it is often very difficult for him/her to give a fresh perspective. Rarely any researcher goes to the participants for the confirmation of responses. Thus, there is no assurance that the responses are appropriate. This leads to the possibility of invalid responses.

4) **Low Response Rates:** Questionnaires face low response from the individuals or concerned people as it is time-taking and sometimes boring. Its response rate is often as low as 5 to 10%, which is unable to serve the purpose of research work. Low response rates affect the reliability of a questionnaire severely.

5) **Requires the Respondent to be Educated:** A questionnaire requires that the respondent has a particular level of education and awareness otherwise he might not be able to answer the questionnaire.

6) **Difference in Contexts:** The wordings of a questionnaire can often mean different things in different cultures. Hence, a standardised form is not always possible.

   For example, a company doing research in India will have to make changes for respondents in North and South India.

7) **Possibility of Misunderstanding:** Many times the behavioural expressions of the respondents are not exactly identified by the researchers. Irrelevant answers or answers of misunderstood questions can cause a trouble in data analysis.

3.4. OBSERVATION

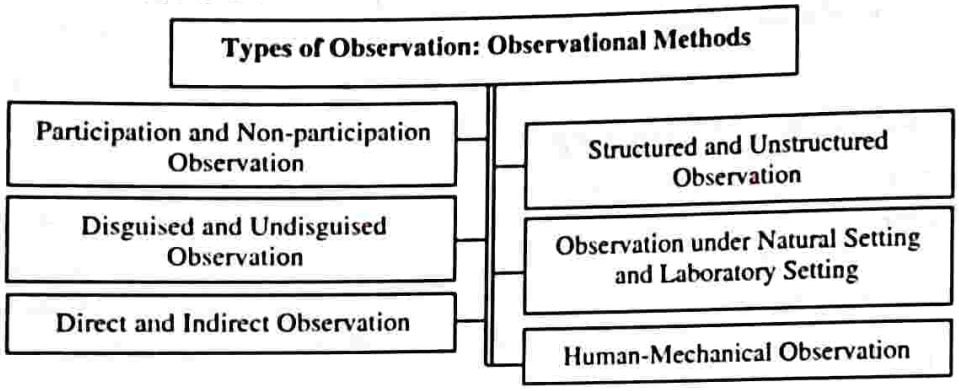
3.4.1. Introduction

The method involving the systematic recording and assessment of behavioural forms of a particular individual (or group of individual), object or event so as to collect desired information about a research problem without any personal communication is called 'Observation'. Here, the observer observes the object from a suitable distance or through audio-video recordings. The information is recorded for future use. The respondents may be observed in their natural environment or a contrived environment is designed for the purpose. The approach for observation may be direct or indirect, structured or unstructured. The observation method is very popular for behavioural science researches.

Every individual observes certain things around him/her but it cannot be termed as scientific observation. Scientific observation is the observation where a particular research problem is the focus of the observation. A systematic planning and controlling is required for recording such observations. Different validity and reliability check measures are used here so as to collect accurate information.

3.4.2. Types of Observation: Observational Methods

Types of observations are as follows:


Types of Observation: Observational Methods
Participation and Non-participation Observation
Disguised and Undisguised Observation
Direct and Indirect Observation
Structured and Unstructured Observation
Observation under Natural Setting and Laboratory Setting
Human-Mechanical Observation

1) **Participation and Non-participation Observation:** This classification is based on the type of role played by the observer/researcher as a particular or non-participant in the process of observation. At one end is the complete participant, moving to the participant-as-observer, then to the observer-as-participant, and finally to the complete observer (non-participant observer). The move is from complete participation or attachment to complete non-participation or detachment. Participation and non-participation observation can take following forms:
   i) **Participant-As-Observer:** As a participant-as-observer, the researcher would take a more participatory role in the organisation's activities. This role might be an established one, e.g., as an employee within the organisation. They would be taking part in the activities in which the participants were involved. The observations, therefore, would be carried out in a naturalistic setting and the participants would be aware that they were being observed.
   ii) **Observer-As-Participant:** Further along the dimension, at the point when an observer starts to act as d participant, there would be more interaction with those being researched. It is likely that the observations would be carried out in a naturalistic selling and the participants would be aware that they were being observed. However, the observer would still remain relatively detached, with the main focus of their role being that of a researcher. They would maintain their metaphorical (and probably physical) distance from the participants involved in the activities.
   iii) **Full-Observer:** As a full-observer, the researcher will have minimal contact, or no contact at all, with the research participants. This would apply, e.g., to psychology laboratory research where there would be limited interaction between the experimenter and participants. The observer located at this end of the continuum would take a relatively detached role. Indeed, the researcher may be undertaking observations covertly and so the participants would be unaware of being part of any research.

2) **Structured and Unstructured Observation:** Structured observation is used when the research problem has been formulated precisely and the researcher is told to observe the area of study. The researchers are asked to record their observations. In structured observation the problem has been clearly defined, hence the

behaviour to be observed and the method by which it will be measured is specified in detail. On the other hand unstructured observation implies that the researchers are free to observe whatever they feel relevant and judicious. In unstructured analysis is used in situations where the problem has not been clearly defined hence it cannot be pre specified whatever we have to specified. It involves researchers watching participants and recording behaviours they feel are relevant to the study being conducted.

3) **Disguised and Undisguised Observation:** With the disguised observation approach, participants do not know they are being observed. This can be done through video cameras, one-way mirrors, electronic measures such as website cookies, or even human observers who look and act like another customer or perhaps one of the employees. Here, the subject or informants do not know that they are being observed.

   In disguised observation the respondents are unaware that they are being observed. Their behaviour is observed using one way mirrors, hidden cameras or other devices. In Undisguised observation the respondents are aware that they being observed. This approach may help encourage the customer to act normally and not be affected by the researcher's presence, though some individuals may alter their behaviour or chokes specifically because they know they are being watched.

4) **Observation under Natural Setting and Laboratory Setting:** Observations in field studies are in their natural setting and are studied in extremely realistic conditions. Sometimes, an experimental manipulation may be introduced in a field study. The primary advantage of using a natural setting is that researchers do not interfere with customers and thus observations are natural reactions. Even if consumers know they are being watched, they will still tend to act more naturally than they may in a laboratory or contrived setting. Observation in a laboratory setting, on the other hand, enables the observer to control extraneous variables, which influence the behaviour of people. Observational studies in laboratory settings have certain advantages over field studies. They enable the collection of data promptly and economically and in addition, permit the use of more objective measurements.

5) **Direct and Indirect Observation:** In direct observation, the behaviour of a person is observed. Most observation research is direct observation, which involves researchers watching participants as the behaviour is taking place. This approach allows researchers to observe not only the behaviour, but also any words spoken and even body language. **For example,** for observing purchase behaviour of shopper for a tea packet, a researcher can stand in a big grocery store just aside the shelf that contains tea packets. He can systematically record the behaviour of flue shoppers such as their first pick (choice) from the shelf, their preference for the hard pack, jar pack, or poly pack; their inclination for a particular brand; impact of price (as the shopper picks a pack and places it back on the shelf after seeing the price), and so on.

   On the other hand indirect observation implies that same record of past behaviour is observed, the behaviour is not observed, and rather its effects are observed. Here the observer engaged in indirect observation generally looks for physical traces of behaviour or occurrence of an event. In indirect observation, the researcher observes outcome of behaviour rather than observing the behaviour. **For example,** a researcher can count the number of cups in which tea is consumed in a product demonstration to note the consumer preference for a particular brand or taste.

6) **Human-Mechanical Observation:** Here observations are done by manually or by machines. Most of the studies in marketing research are based on human observation where in trained observers are required to observe and faithfully record their observations. Humans have the advantage of being able to observe another person's entire repertoire of behaviours from actions to body language to words spoken. Significant data could be missed if a mechanical device were used. However, that ability to fully observe could also result in failure to accurately notice various behaviours if the actions occur too rapidly or the researcher is distracted by another person, the environment, or even the subject's actions that are not part of the study. In some cases, mechanical devices such as eye cameras and audiometers are used for observation. One of the major advantages of electrical/ mechanical devices is that their recordings are free from subjective bias. As against this advantage, such observations may be less valid than human observations. This is because the observer's power of integration can lead to a more valid evaluation of the observation.

   A major advantage of mechanical devices is data accuracy. Unless the machine is malfunctioning or out of proper calibration, it will measure the phenomena being studied accurately. In the field of business research, use of mechanical device has been becoming increasingly popular as these devices are free from the bias caused by human observer.

3.4.3. Process of Conducting Observation

The researchers need to employ observation in a scientific way since it is used as a research technique or a data collection tool which enables them to find out the answers for the various research questions. In order to accomplish this objective, the following steps are required to be adopted by the researchers or observers:

Step 1: Planning for Observation: The first and foremost step in the process of observation is planning. One should not conduct any observation activity in a hasty or unplanned manner. This activity should be planned with care and complete analysis should be done before implementing it. In order to conduct the various activities as planned, the questions such as who, how, when, what, why and where related to the observation activities must be replied by the researcher. By giving concern to the above mentioned issues, a researcher can formulate an appropriate plan which will help him in executing the observational activities.

Following factors must be taken care by the researchers (as advised by **Sukhia et.al.**) while using observational method as a tool of research:

1) All the particular behaviours or activities which are to be observed should be defined clearly.
2) Group or cluster of subjects to be observed should be defined.
3) Scope of the method should be defined, i.e., either individual or group.
4) Number of observation sessions, duration of observation sessions and the time lag between two different observation sessions should be determined.
5) Also the position of the observer, the instrument used and the recording format should be determined.
6) Certain special conditions which may be necessary for the subjects should be defined.
7) In order to record the observations, suitable tools should be designed.
8) Required training should be acquired to be an expert observer.

Step 2: Execution and Recording of Observation: Whatever planning was done in the first step is now required to be executed in appropriate manner. Efficient execution and recording activities undertaken by the observer becomes the key for successful observation. In order to accomplish this objective, below mentioned points must be taken care of:

1) Based on the setting of observation, i.e., natural or artificial environment, the factors and situations concerning the subject should be determined. No specific setting is required for observation in natural environment, whereas, various factors and situations need to be designed for observing the subject in the artificial environment. Some of the examples of such activities can be creating rapport with the subjects, favourable encouraging environment, seating arrangement for the subjects, and so on.
2) In order to record the on-going activities of the observation, it is important for the observer to be careful, alert and attentive. The various things which are to be observed must be recorded properly by arranging suitable tools. If during the observation, one is not in condition to record the observed points, then these points should be remembered and noted down as soon as possible after the observation.
3) Higher level of objectivity has to be maintained by the observer while observing, classifying and recording the things and events. This can be achieved by minimising the impacts put on by observer's personal values, biases, attitudes, likes and dislikes on the outcomes of the observation.
4) The following methods are mainly used by observers for recording the observations:
   i) Utilising rating scales, observation schedule, checklists, blank forms and score cards.
   ii) Use of narratives, i.e., using own words for elaborating the things which are being observed.
   iii) Using various technological and mechanical devices such as mechanical counters, audio and videotape recorders, video tapes, stopwatches, one way mirror rooms (so that observers can see the subjects without being noticed by them), concealed microphones and video tapes, motion pictures or films, computer technology, binoculars, audiometer, camera, etc.

Step 3: Interpretation of the Observed Results or Findings: In this step, the interpretation of recorded and categorised observation data is done so that the various research questions can be answered. In deriving suitable and valid conclusions and inferences from the observations which are recorded, special cautions must be taken by the observers. The obtained conclusions and inferences should have objectivity, validity and reliability on part of the observer/researcher. In order to generate the appropriate and genuine interpretations of the observation, the researcher should not have any kind of confusion, prejudices, subjectivity biases or rigidity.

3.4.4. Significance of Observation

Following points highlight the significance of observation method:

1) **Suitable for Non-verbal Behaviour:** Generally, survey method is used to collect the verbal information from different respondents, but in case of collecting information through non-verbal behaviour, observation method is useful. In-depth information about the respondent can be collected through observing his/her behaviour.

2) **In-depth Information:** Due to prolonged closeness between the observer and the respondent, a healthy and informal relationship is developed between them. The closeness increases with the time. It leads to exploration of in-depth and private information from the respondent.

3) **Free from Biasness:** As the behaviour of the respondent is observed in natural setting, it is free from biasness. Genuine and reliable information is generated through observation method.

4) **Useful in Longitudinal Analysis:** Observation method is very useful for longitudinal analysis as the observation may be continued to prolonged period.

3.4.5. Limitations of Observation

Different limitations of observation method are as follows:

1) **Lack of Control:** In observation method, the most critical point is the nature of control. It is not possible for the observer to control the natural variables affecting the behaviour of the respondent.

2) **Difficulties of Quantification:** Another limitation of observation method is the absence of quantification of data. The behaviours of respondents cannot be quantified, only the nature of their behaviour may be described for research purpose.

3) **Small Sample:** Observation method is based on small samples, thus, these may not be the representative of the total population.

4) **Costly:** In order to observe large samples, more observers need to be assigned. As the observation method is time-taking, more remuneration is required to pay for observers.

5) **Difficult to Obtain Permission:** In cases, where the observer is required to observe a particular institution or organisation, permission is to be taken from the administrator. It is not easy to get permission in such cases.

3.5. SURVEY

3.5.1. Introduction

The process of gathering relevant information from a sample of population with the help of questionnaires is known as survey. It is a systematic and planned effort where the sample (or respondents) accurately represents the population and the responses are directly collected from the respondents. When the questions are asked one-on-one to an individual(s), it becomes an interview.

Among other important fields of measurement, surveys also form a critical part in applied social research. The scope of surveys is very broad and covers any measurement technique that includes gathering responses from the respondents. Therefore, a survey can range from a concise feedback to a thorough personal interview.

Surveys are quantitative in nature and can be regarded as a common form of social science research. Here, the researcher chooses respondents from a given population and presents a standard set of questions to them. The survey may take the form of an online questionnaire, a written document (required to be filled in by a person) or a telephonic or a personal interview. With the help of surveys, one can gather data from small as well as large populations.

3.5.2. Methods of Survey

Following are the methods that are commonly used in surveys:

1) **Mail Survey:** It incorporates sending questionnaires to the respondents in the form of mails. The respondents are prompted to complete the questionnaire and return it. This method of survey is used when the sample of respondents is widely distributed and limited funds are available to conduct the survey. Mail

surveys prove to be less costly as compared to a personal or telephonic interview only when the rate of response gives desired and consistent results.

2) **Telephone Survey:** It incorporates calling the respondents over a telephone and asking them questions. One benefit that it has over mail survey is that here the interviewers can prompt the respondent to answer the questions which can be examined instantly. However, those who are low on budget and wish to conduct the research via telephones, find that the interviewers charge high prices.

3) **Personal Interview Survey:** Personal interviews are face-to-face interviews. These are employed either when the survey is so long that it cannot be conducted over a phone or when the interviewer wants to show something to the respondent. Personal interviews prove to be more effective when the respondent is required to taste the product or the product is placed at an office or home, or when the respondents demand to conduct the interview personally.

4) **E-mail Survey:** These are among the most popular methods of online research till date. With the help of this method, people can copy the URL of an online survey company to their own e-mail. They can then send it to the respondents who can then finish the survey by clicking on the survey URL and opening it.

5) **Online Survey:** It involves systematic collection of data which incorporate inviting the respondents and encouraging them to complete the survey over the Internet. This method of survey will be beneficial only when the respondents have an access to the internet. A little proficiency over the internet is also required on the part of the person conducting the survey.

6) **Social Media Survey:** People can create and engage in online communities with the help of social media platforms. Such online communities are gaining huge popularity and they connect people who have similar tastes and opinions. They like to share information and ideas that interests them with each other. Survey conducted through such people is known as social media survey.

3.5.3. Significance of Survey

The significance of survey can be understood with the help of following points:

1) **Cost:** Survey is an economic way of collecting information from a wide population. The cost incurred on a single respondent is very less. Even if the respondents are given incentives to participate in a survey, the cost per respondent of a survey as compared to a telephonic interview or a focus group is very small. Surveys also give responses which are greater in number than any of the above mentioned methods.

2) **Data Collection:** Collecting data with the help of surveys is very easy. Surveys employ data sources which are readable and which can be collected and examined as per the needs of the market research.

3) **Increased Data Collection Accuracy:** In order to acquire accurate information, the respondents need to provide honest answers. Therefore, surveys, due to their ambiguous nature, helps respondents to be more open and give honest replies compared to other research methods. In fact, respondents taking the survey online are not rushed into giving correct responses as they can take the surveys in their own time. This increases the quality of responses in online surveys.

4) **Flexibility:** Surveys enable flexibility in the manner of putting forth the questions to the respondents. This is because surveys can take the form of personal or telephonic interview or an oral, written or online survey.

5) **Versatility:** Surveys are versatile in nature that means they are applicable in most forms of research which could include political, market, social and psychological research.

6) **Sample Size:** With the help of surveys, the researcher can reach out to a wide population which allows drawing inferences from a more accurate sample.

3.5.4. Limitations of Survey

Certain limitations of survey are as follows:

1) **Inflexible Design:** Surveys can be inflexible in nature in the way that the method once chosen to conduct the survey cannot be altered during the course of collecting data. This can prove to be a major weakness of surveys.

2) **Not Ideal for Controversial Issues:** It is difficult to know the actual truth behind controversies. Therefore making the respondents answer questions that are controversial in nature may not prove to be beneficial in acquiring appropriate data.

3) **Possible Inappropriateness of Questions:** The researcher has to create and put standard questions in the surveys so that the common public could understand them. But such questions might not prove to be appropriate for everyone. **For example,** asking questions that deal with the emotional state of individuals.

4) **Sample Choice:** The researcher should be careful in choosing a sample that accurately represents the population. Sometimes researchers just make assumptions about a sample which might not be appropriate. This is referred to as researcher error which may occur in surveys.

3.5.5. Survey *versus* Observation Method

Basis of Comparison	Survey Method	Observation Method
Objective	Survey method is mostly applicable to social research where there is a large population.	The observation method is considered to be superior in comparison to experiments, surveys and documentation studies for gathering data for behavioural research.
Response	Surveys include limited questions. Also the responses are mostly verbal in nature. Therefore, the data gathered through surveys could be biased.	In comparison to experiments or surveys, observations are neither artificial nor restrictive.
Difficulties of Quantification	Usually, the measurement in surveys involves the quantitative measure of the researchers. They are more quantitative in nature and try to acquire logical data.	Usually, measurement in observations involves the unquantified measure of the observers. They are more non-quantitative in nature and try to acquire a more humanistic and emotional data. They also try to establish humanistic relationship with their test subjects.
Sample size	The sample size of surveys is usually large.	The sample size of observations is smaller than surveys but larger than experiments.

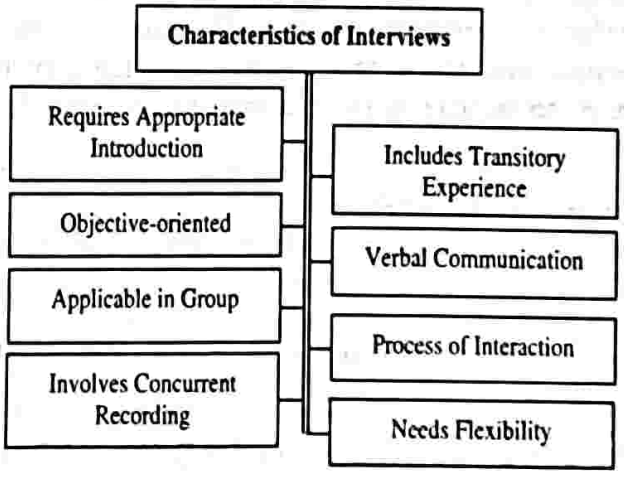
3.6. INTERVIEW

3.6.1. Introduction

Interview refers to an exchange of ideas among a group of two or more than two people, where the interviewers ask the questions to interviewees in order to extract the requisite data from them. The process of interview consists of acquiring information by putting forward various verbal stimuli and getting the responses in verbal forms. The interview can be carried-out through various methods, as per the conveniences.

Interview is a very significant method for collecting the data. It can be a collaborative and organised communication between the researcher and the respondent, which is usually done to acquire information related to a particular field of study. Not only the oral communication, but also the body language of the respondent, his facial expressions, gestures, pauses, and the settings play a crucial role in the interview method. The basic requirement for taking the interview is either face-to-face contact or the telephonic contact with the respondents. The basic skill of interviewer in conducting an interview is also very important. The interview is generally carried-out with the help of a structured interview schedule or even through an unstructured manual.

3.6.2. Characteristics of Interview



1) **Requires Appropriate Introduction:** Since the interviewer and interviewee are not familiar with each other, it becomes essential for the interviewer to give his suitable introduction.

2) **Includes Transitory Experience:** The participants establish a momentary relationship with each other. It starts and ends at particular points. The interview renders a transitory experience for them.

3) **Objective-Oriented:** Interview cannot be said as a simple, informal exchange of ideas, rather it is an interaction carried-out with particular objective, i.e. to acquire the data related to a particular field of study.

4) **Verbal Communication:** In the method of interview, questions are asked verbally in order to draw verbal responses.

5) **Applicable in Group:** Though usually the interview is carried-out between two people, but it is not mandatory. There is a possibility to carry interviews with a group of people like family members, a class of students or a cluster of customers, as per the requirement of research objective.

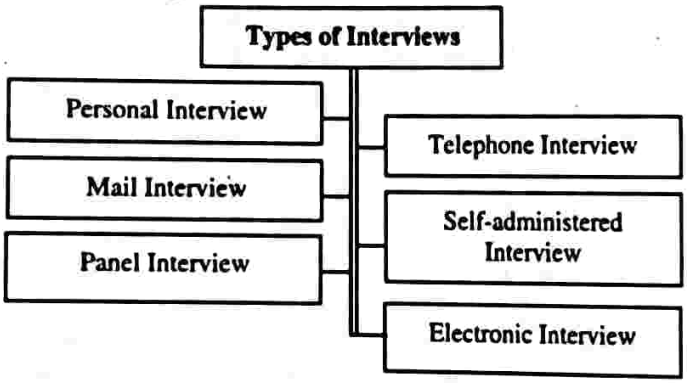
6) **Process of Interaction:** The process of interaction between the interviewer and interviewee is highly dependent on the perception about each other. The response of an interviewee is affected by the looks, conduct, body language, voice modulation of the interviewer, and how powerfully he perceives the question along with his own individual desires.

7) **Involves Concurrent Recording:** The interviewer has to record the information provided by the interviewee. Along with this, arises the need to check that the recording of information does not hamper the flow of discussion.

8) **Needs Flexibility:** Interview is a flexible psychological process unlike the standardised chemical processes. This implies that the interviewer has to be careful while applying the rigid standardised tests, since in interview; he has to handle human beings having changing drives and different insights. The degree of success of an interview mainly relies on the perception and proficiency of the interviewer in handling the changing socio-psychological conditions.

3.6.3. Types of Interview

Various types of interviews are as follows:



1) **Personal Interview:** In most of the cases, information is acquired through personal interview. In the process of interviewing, the interviewer needs to put up pre-planned questions and has to record the responses obtained. The major benefit of this type of interview is that persons generally reply when the questions are asked face-to-face. Moreover, the interviewer has the ability to note down particular reactions and remove any sort of confusion regarding the questions. The main shortcoming of the personal interview is that this method is expensive than other method. Another major limitation is related to interviewers. In case, the interviewers lack proper training, there are chances of divergence from the purpose of research, which might result in introduction of biasness in samples.

The types of personal interviews are described below:

i) **Structured and Direct Interviews:** Generally, direct interviews are arrangement of set of questions related to a subject with probable correct answers mentioned against each question and respondents have to identify the correct answers. The questions are related to a particular subject and reply given by the respondents indicates their depth of knowledge.

ii) **Unstructured and Direct Interviews:** The structured interview gives limited knowledge about the respondents because the interview is restricted to a set of questions. Sometimes it is desirable to know

reasons behind certain happenings. The respondents are given a topic and full freedom to express themselves on the topic. In this way a free flow starts from the respondents and interviewers receive a wider spectrum of feedback to arrive at a conclusion.

iii) **Structured and Indirect Interviews:** This type of interviews avoids any type of inclination or prejudices between interviewers and respondents. This makes it superior to structured direct interviews. The respondents are asked unrelated question other than the main question and inferences are drawn from their replies. It is a well-known fact that memory, perception and knowledge of respondents very much depend upon their pattern of thinking. This makes the respondents not to respond to direct questions. In such cases other option left is to dig through unrelated questions and make a conclusion. In such cases the interviewer has to be an expert on human behaviour to make a correct guess work.

iv) **Unstructured and Indirect Interview:** The unstructured and indirect interviews are best established procedure for giving a forecast based on present trends. The respondents have freedom to interpret a situation in their own way. There are different types of procedures which are adopted for making an estimate of situation. The most common methods used are to write the word that comes to mind after seeing a photograph, incomplete sentences are given for completion or shown a set of pictures and asked to narrate a story.

2) **Telephone Interview:** Telephonic Survey Interviewing techniques are applied for limited information. These are commonly used in lieu of Personal Interviews due to the involvement of less time and more economic. However, it cannot be compared with Personal Interviews due to limitations over adoption of differential functions. During telephonic conversation it is not possible to go into very much in details to find the depth of knowledge instead it is more suitable to know about the instant reactions over an event or programme on radio or television. Moreover, unstructured question may not be replied by the respondents over telephone.

These are very good for taking an opinion poll of public. Instead of personal contact in Personal Interviews, the interviewers and respondents discuss through telephone and interviewer has freedom to put up subsequent questions to know more details.

It is a systematic way of collecting public opinion using set of questions on a topic. The opinion may be sought from general public or person of repute. The telephonic interview data is preferred over others due to maximum response and quality of data. There are certain constraints with this system of interview due to the non-availability of telephone numbers to many subscribers, many do not like disturbance of their home privacy and lengthy interviews are not liked by people.

3) **Mail Interview:** The construction of questionnaire plays a major role in mail interview due to physical absence of the interviewer for putting-up the questions and recording the responses. It is almost impossible to carry out mail interview in case of unstructured study. In this regard, personal interviews and telephonic interviews offer more flexibility as pausing any time or modifying the directions is at interviewer's dispose, while in case of mail interview, the interviewer completely loses control after dispatching the questionnaire. A covering letter is sent along with the questionnaire, guiding the respondents regarding filling the questionnaire followed by mailing it back to the investigator. This type of interview offers more flexibility as respondents are free to fill it as per their comfort and free time, and then mail it back to the researcher. The structuring, pre-testing and compiling of questionnaire of such interviews has to be done with more care as compared to that of the personal interviews.

4) **Self-administered Interview:** This process of interview makes the respondents who are eye witness to an accident to recall their memories and give the detailed account of accident. The greatest advantage of self-administered interview is that it gives the first-hand account without any bias and can be considered as correct. It very much depends upon the maturity and presence of mind of the interviewer to make the respondents to divulge some more information which is relevant and important for further questioning. This system needs more time and deputation of more manpower and there are chances of corruption of information data due to inclination or prejudices of interviewers. The narration of information starts from the respondents without any structured questionnaires or the computer and hence, it is in most natural form. The information is solely generated from the respondents and there are no explanations or feedback, it remains open ended.

5) **Panel Interview:** In Panel Interview system the company in need of man power hires a company for selection of candidates. The details of expertise, qualifications and experience are handed over to hiring company. The hiring company hires a group of experts derived from different fields like technical, humanities and representative from the company needing man power. The hiring company makes screening of applicants and gives its recommendations on selection. Panel Interviews are now very common in top companies as well as public sector undertakings. The selection panel consists of experts or heads of corporate offices. It is found to be most easy and efficient way of selection. The same panel takes interview with similar topics at regular interval of time for a considerable period and this ensures the quality of selected candidates. The information data is received through a panel which remains unchanged for a certain period which ensures reliability of trends and changes given by it.

6) **Electronic Interview:** The types of electronic interviews are discussed below:
   i) **FAX:** The survey data collected through FAX has also picked up recently. It is faster than E-mail. However the print quality in FAX remains inferior to e-mail despite advancements in technologies. It is generally limited to business establishments rather than individuals, since the FAX machines are more popular with business establishments rather than individuals.
   ii) **Internet Survey:** It is easy to conduct. It consists of small text, small visual presentation and small interactive capacity. Complex or skip patterns are not used in this system. However Web surveys provide great number of options to researchers along with audio and video affects.

3.6.4. Significance of Interview

Significance of interview is as follows:

1) **Timely Provision of Participants:** At times the participants are willing to respond to the questions of interviewer, but fail to appreciate the underlying driving force for their behaviour. The questions put by the interviewer help the people to find out the utility of goods or services. But, generally people do not want to spend time thinking about the motives behind their reasons unless they are encouraged to do so.

2) **Can be Conducted at Diverse Set-Ups:** Since, the only basic requirement for conducting the interview is an interviewer and an interviewee, without the need for any particular provision or tool, it may be conducted at any place as per the convenience of the participants. It is possible to conduct the interview at the residence of the interviewee, especially in those cases when the interviewee is not able to travel. It is also feasible to conduct the interview in the office, which would be more comfortable in case of the expert interviews, in which the interviewer is looking to reduce the chances of nuisances. In the end, intercept interview can be conducted in the public places such as markets where it is quite easy to find a participant.

3) **Applicable in Detailed Areas:** Interviews are specifically useful for handling the subjective areas which require detailed and comprehensive information. It would be feasible to investigate the topic and problem further over a long time.

4) **Valuable Insights:** There is a possibility of getting valuable insights on the basis of depth of information acquired and the knowledge of the primary informants.

5) **Tools:** There is a need for only simple instruments in case of interviews as its success mainly depends upon the communication skills of the researcher.

6) **Knowledge about Interviewee:** Interviews are regarded to be an excellent means to generate information on the basis of concerns, point of views and background of the interviewee. The interviewee can elaborate their ideas, can give explanations of their point of views and can recognise what is considered to be vital for them.

7) **Flexible Approach:** Interview is possibly one of the most flexible methods of data collection. It offers various chances of alteration as per the demands of investigation during the interview. It also helps in forming the outline of the interview.

8) **High Rate of Response:** Usually the interviews are pre-planned as per the convenience of time and place. Hence, it offers comparatively high response rate.

9) **Soundness:** As at the time of the interview, the interviewer has direct contact with the interviewee, he is in a position to check the preciseness and the importance of the information acquired. Online interviews offer the chances of removing the faults while entering the data. The interviewer does not have to rely on the

methods like tape-recorded interview in case of which there can be doubts regarding clarity of 'what is heard' and as a result it raises uncertainty regarding 'what was actually spoken'. With the help of internet, the interviewer can acquire the response in the form of written text acquired from the public places where it is quite easy to locate the respondents.

10) **Employed to Acquire Factual Information:** Every research is not concerned with the consumers of non-profit firms. Instead few studies are carried on with the help of experts, in order to draw insights related to the issues of the firm. Moreover, it is also possible that the firm takes interviews from the staff of the rival firms. The basic design of such investigation targets not at acquiring behavioural insights, but rather on acquiring factual information. The interview has a better success rate as there are chances that specialists would definitely give a reply when questioned personally, in comparison to written investigation. In fact, the expert cannot get anything from the investigation except to help the associates in their issues.

3.6.5. Limitations of Interview

Following are the limitations of interviews:

1) **Prolonged Process:** The process of data analysis can be challenging and time-taking. Most of the tasks in the preparation and analysis of the data has to be carried-on till the end, unlike the pre-coded questionnaires, in case of which, data can be immediately analysed once it is collected. A chief task for the interviewer, once data is collected is transcription and coding of the data.

2) **Analysis of Data:** There are chances of generating non-standardised results in the case of interview method. Unstructured and semi-structured interviews have a comparatively open format and results are not pre-coded data.

3) **Consistency:** Due to the influence of the interviewer and the circumstances, attaining stable and reliable data is somewhat difficult. To some extent, the collected data is distinctive due to the presence of particular individuals and situations. This, however badly affects the reliability of data.

4) **The Influence of the Interviewer:** The basis of information acquired in the interview is the words of respondents instead of their actions, as there may be disparities between the two. What the people are saying that they do, favour or believe; can be another way true. Specifically, the personality of the interviewer can influence the words of the interviewee. However, such problems can be overcome in the case of the online interviews when the verbal and visual hints are missing.

5) **Reluctance to Answer due to Inhibitions:** When the interview is conducted face-to-face or by using an audio/video recorder, there are chances that the interviewee is reluctant to answer due to inhibitions. Though, the influence of recording equipment might go away, but it is not always so. In case of an interview, artificial circumstances (like in the case of experiments) are created, where the persons have to speak on such records.

3.7. EXPERIMENTS

An experiment is a process whereby the researcher influences an independent variable in order to check any change on the dependent variable. It includes experimental groups and control groups. The former is exposed to the experimental treatment whereas the latter is not. The researcher measures the dependent variable after allocating the groups to the participants (either experimental or control) randomly. Then, the researcher again measures the dependent variable, but this time after exposing the experimental groups to the treatment. If the participants were allocated random groups, then it can be concluded that the change in the independent variable causes a change in the dependent variable among the groups.

For example, evaluating the effect of welfare payment on employment can be a form of social problems experiment. Here, welfare payment is the independent variable whereas employment is dependent. The researcher can form experimental and control groups comprising single and unemployed mothers and provide welfare payment to the experimental group and not to the control group. The hypothesis that the researcher could form might be – the probability of the experimental group to have a job after 1 year is less than that of the control group.

Experiments give proof for the cause-and-effect relationships, i.e., they measure the affect that one variable has over another with certainty. However, experiments are conducted inside labs and on a very small sample size therefore, the conclusions might not be generalised to real life settings.

A formal definition of experiments could be that they are research investigations carried out in controlled conditions whereby any manipulations in the independent variable may cause changes in the dependent variable. Experiments help in establishing a cause-and-effect relationship among different variables keeping other variables constant.

Therefore, we can say that experiments are intentional investigations whereby the researcher keeps the variable to be studied under controlled conditions in order to study its effects. On the other hand, surveys are methods to gather information from a sample of a population about a certain phenomenon.

3.8. SECONDARY DATA

3.8.1. Introduction

When a researcher uses data which are previously collected by some other researchers, institutions, or agencies for their own purposes are called secondary data.

The researchers collect secondary data either from an internal source of an organisation, or from the published sources like reports and journals. The purposes of data may vary from that of the current study. Hence, few portions of this data may be used for current research problem. It should be kept in mind that, secondary data needs to be processed before applying in research, as the contexts of data may have changed and modified as per their own purposes.

For example, Total contribution of different sectors to the GDP are published by the government or some trade association, which may be a secondary data source for analysing the current market position of a particular organisation within a particular industry. That published data may provide the required information or fraction of it.

Secondary data helps in various activities in a research study, such as, generating new ideas, analysing the needs previously addressed, understanding the tools and techniques used for similar cases, save the time, etc.

Secondary data is given preference in the situation where a research has to be completed in shorter time duration.

3.8.2. Primary Data *Versus* Secondary Data

Basis of Difference	Primary Data	Secondary Data
1) Meaning	The data is collected by the researcher himself for finding the solution of a particular problem or situation, is known as primary data.	When a data, which was earlier created by some researchers or organisations for their own purposes, is used in current research for a similar purpose, it is known as secondary data.
2) Cost	The collection of primary data is costly as it includes several tools and techniques.	It is less costly than primary data collection. The secondary data can be obtained easily, involving zero or very less amount of money.
3) Sources	It is directly collected from respondents.	It is collected from some already available published or unpublished sources.
4) Methods	The methods used for primary data collection include interviews, questionnaires, observations, and surveys.	The methods used for secondary data collection include studying and analysing reports, journals, census, and different databases.
5) Reliability	Primary data is more reliable as it is original and new.	The reliability of secondary data is comparatively less reliable, as this data belongs to different problem or situation.

6) Scientific Method	The selection of primary data is scientific in nature. It includes forming hypothesis about the problem or situation, collecting data, and analysing data to prove the hypothesis right or wrong.	The selection of secondary data is manual. It is selected according to the content of the source and the current research topic.
7) Precaution	Precautions are relatively nominal in collecting primary data than secondary data.	A lot of precaution is taken in the selection of secondary data.
8) Form of Data	Form of primary data is like raw which needs to be processed to get meaningful information.	Secondary data are already processed data that needs to be analysed and studied to use in research study.
9) Accuracy	Primary data is original and accurate, as it is developed according to the need.	The secondary data is not completely accurate as it was developed for some other purpose.

3.8.3. Methods of Collecting Secondary Data

The secondary data can be collected in following manner:

1) **Internal Secondary Data:** Secondary data generated within the research conducting organisation is known as internal secondary data. Data generated within the organisation can be either formal or informal. Formal data are generated periodically in a structured layout such as reports of various departments, half yearly reports, etc. On the other hand, informal data are not periodically generated such as conceptual booklets, new policy frameworks, etc.

   Formal internal data can be collected from following major sources:

   i) **Sales Analysis:** Sales analysis reports generated within the organisation are important internal source of secondary data. These reports contain the information about the sales pattern and fluctuations in market position. These can be very useful in drawing the solution of related problems.

   ii) **Invoice Analysis:** The invoices of an organisation also act as a secondary data source. These invoices help in understanding the sale and purchase pattern of the organisation in different situations or scenarios. The information collected through the invoices may be summarised carefully to reach a particular solution. Various data related to customer can be obtained with the help of invoices, such as, name of customer, type of product, location of product delivered, etc.

   iii) **Financial Data:** Researchers can get a lot of financial data recorded within the organisation. These records may contain the information regarding production cost, storage cost, transportation cost, sales cost, etc. these data are very useful data for marketing research. These financial data are periodically generated from time to time, and hence are updated.

   iv) **Transportation Data:** The transportation data regarding the routes, vehicles, loads, etc., provide a lot of information regarding the transportation activities. These data allow the researchers to analyse the trade-offs between various costs and determine the ways to get maximum financial benefits.

   v) **Storage Data:** Various costs associated with storage, such as, handling cost, maintenance cost, etc., are the important data that are generated within the organisation. These data help the researchers in analysing various pros and cons related to the storage of materials and therefore suggesting suitable methods to be adopted.

2) **External Secondary Data:** Sometimes, important secondary data is not found within the organisation. The secondary data derived from different sources outside the organisation is known as "external secondary data". Some important sources of secondary data are as follows:

   i) **Libraries:** Library is one of the external secondary data sources, which the researcher may use to collect the necessary information for the research. Different kinds of libraries provide a range of data for the research. Books related to research topics, journals, magazines, research papers, etc., are available in various libraries, maintained by different organisations and institutions.

   ii) **Literature:** A variety of literature is available on different subjects and issues. These literatures are the result of extensive research practices. There is plenty of valuable information in such kind of sources, which can be utilised for the resolution of current research problems.

   iii) **Periodicals:** Business periodicals are published at regular time intervals, *viz.*, yearly, half yearly, bi-monthly, fortnightly, quarterly, etc. The secondary data are published by various government and non-

government agencies regarding finance, trade, transport, industry, labour, etc. These periodical contain various trends, future prospects, opportunities in market, etc., which can be used by researchers in their current research problem.

iv) **References and Bibliography:** The references and bibliography of a particular research or journal can be a useful resource for deriving secondary data related to specific issue. Researchers can take a huge amount of data which can then be analysed to get deeper insight.

v) **Census and Registration Data:** Data collected through census and different registration programs may become very useful in deriving secondary data. As this data is collected through extensive effort and field work, it contains the appropriate information about various issues like, agriculture, trade, transport, banking, etc.

vi) **Trade Associations:** Large amount of useful data may be derived from trade associations as these contain the relevant information about the changes and happenings in the industry. The information from one trade association is exchanged with other trade association for updating the information content. Research firms gain the access to different information from these associations.

vii) **Government Departments:** The information available from government departments may be utilised as secondary data in research process. Government departments can provide various information regarding position and growth of different sectors of an economy like finance, banking, trade and transport, agriculture, etc.

viii) **Private Sources:** There are many organisations which publish the statistically processed data for further use. These are the private institutions which perform primary research about particular events or situations and compile the final facts and figures. Some of the examples of such sources are Economic Times, Financial Express, Indian Marketing Association, etc. The researchers engaged in current marketing research can utilise the information available from these institutions by purchasing journals, magazines, newspapers, etc., which are publicly available.

ix) **Commercial Research Institutions:** Some institutions in the market deal in purchasing and selling of different kind of data or information, which are collected through research. Many market research institutions are in the business of providing statistically processed data or information, by taking help of secondary data or by conducting fresh surveys.

x) **International Organisations:** Several international organisations like World Health Organisation, World Bank, International Monetary Fund, International Labour Organisation, Asian Development Bank etc. are helpful in deriving required information or data about a particular research.

These organisations have plenty of information or resources to provide data about issues like population, inflation, agriculture, education, labour problems, child problems, women development, trade and transport, etc.

3.8.4. Significance of Secondary Data

Secondary data is significant for research in following ways:

1) **Economic:** The secondary data is easier and cheaper to access. It is more economically collected compared to the primary data. Some of the secondary data can be obtained with absolutely no cost.

2) **Less Time Taking:** As secondary data is already processed and compiled by other researchers, it takes very less time to collect this data. There is variety of secondary data available from various sources. Hence, researchers just need to search the data from the sources.

3) **Quality:** The quality of the secondary data is unique and rare as these are originally collected by trained professionals who have expertise in data collection. Hence, for a researcher it is very difficult to match that level of quality single-handedly.

4) **Measuring Instruments are not Required:** In collecting secondary data, there is no need to decide the tools and techniques for gathering required information, as this data is already recorded and processed by other researchers. The researchers only need to identify the relevant section of this data which is of their concern.

5) **Availability:** Secondary data is widely available and hence easily accessible. Secondary data are helpful especially when it is quite difficult to collect primary data. Majority of secondary data is available which can be utilised for a particular research.

6) **Bases for Comparison:** Secondary data can also be used for comparative analysis with primary data. This way, researchers can make many interpretations regarding the data.

7) **Useful in Exploratory Research:** As exploratory research is conducted with the purpose of getting better insight about an issue or phenomena, secondary data is very useful in serving its purpose by providing extensive available information from various sources. This helps the researchers to carry out the research accordingly.

8) **Generates Feasible Alternatives:** Secondary data is a source which provides a variety of alternatives to researchers related to various problems in research. Researchers are required to analyse and study the solutions provided by these data through various approaches, sources, and methods, etc.

3.8.5. Limitations of Secondary Data

Secondary data has following limitations:

1) **Relevance:** As secondary data is collected by other researchers for other purposes, therefore, these data may not be relevant for the current research work. The secondary data may vary because of many reasons, such as, measurement and scaling, sampling technique, data analysis technique, purpose of research, time duration, etc.

2) **Accuracy:** The accuracy of secondary data is questionable due to many reasons such as using inappropriate data collection method, researcher biasness, inappropriate sampling technique, etc., due to which Secondary data may not be accurate every time.

3) **Obsolete Data:** There can be a significant time gap between the secondary data and present requirement, and it is obvious that many times secondary data may contain obsolete information which is not applicable for present scenario. Therefore, including such data can be a risk to the effectiveness of research work.

4) **Non-Disclosure of Research Findings:** It is not always easy to have access to all the findings of a particular research. Some organisations or research institutions may not allow its disclosure.

5) **Difficulty in Tracing-Out Sources:** Sometimes researchers or individuals are not able to identify the appropriate sources of secondary data. Due to this limitation, the validity of secondary data remains doubtful.

3.9. SAMPLING

3.9.1. Introduction

Sampling is a process in which the fixed numbers of observations are taken randomly from a larger population.

A technique which is fundamental for behavioural research is known as sampling and without using it, research work is not possible. It is impracticable and impossible to study the whole population due to practical limitations of cost, time and other factors that are indispensable and operative in studying the whole population. For the sole reason of making the research findings economical and accurate, the concept of sampling has been introduced. **For example**, for taking decision about to purchase or not to purchase the fruits, a fruit merchant inspects randomly only a few of them rather than examining each and every fruit. The important objective of sampling is to obtain maximum information of the population under study using minimum of money, labour and time.

A definite plan to obtain a sample from the sampling frame is **sample design.** The method or technique which is adopted by the researcher in selecting the units of sampling from the population is called sampling design.

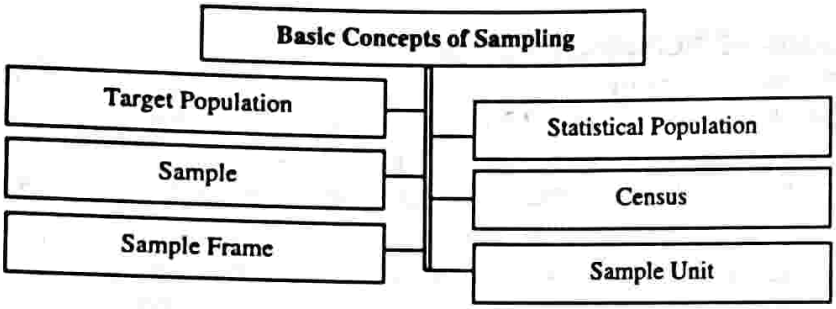
According to Cocharn, "In every branch of science we lack the resources, to study more than a fragment of the phenomena that might advance our knowledge". In this definition a 'fragment' is the sample and 'phenomena' is the 'population'.

According to Davis S. Fox "in the social science, it is not possible to collect data from every respondent relevant to our study but only from some fractional part is called sampling".

The basis for selecting a sample survey is the framework or roadmap which is called sample design and it affects other important aspects of the survey. For obtaining some type of relevant information using survey, researchers execute it for some population, or universe. The sampling frame must be defined in such a way that it represents the population of interest out of which a sample is to be drawn at random. This sampling frame should be either identical to the population or may be a part of it. The sampling frame can be indirectly related to the population subject to some under coverage (e.g., the population is preschool children and the frame is a listing of preschools). The design of the sample may be simple or complex which provides the fundamental plan and methodology for the selection of the sample.

3.9.2. Basic Concepts of Sampling

Following are the basic concepts of sampling:



1) **Target Population:** The entire group of units, being the focus of study, is represented by the population or universe consisting of all the persons in the country, in a particular geographical location, or a special domestic or economic group based on the purpose and scope of study. Non-human entities like farms, houses or business establishments also comprise population. **For example**, if a study is to be conducted on the marks obtained by the students of Statistics then the 'universe' will be all the students of that subject in that class. If the class is consisting of 50 students then the 50 students is the 'universe'.

   "Population or universe" is the sum total of the objects under study, both animated and in animated. Thus, numerical details of the collection of the individuals or of their qualities, or of results of the operations are known as universe. Universe can be classified as follows:

   i) **Finite Universe:** A 'finite universe' comprises of finite number of entities or members. **For example,** the universe of the heights of students in a particular class or the universe of smokers in the Lucknow district.

   ii) **Infinite Universe:** If the infinite numbers of members are included in a universe then it is called "infinite universe". **For example,** the universe of pressures at various points in the atmosphere.

2) **Statistical Population:** To draw out statistical inferences from the set of entities of statistical population is based on random sampling of the population. **For example**, to derive generalisations about the crows, to only the set of crows should be the interest of study. However, if one chooses a population such as 'all crows', then the limitations will be in observing crows both the existing as well as existing in the future. There will be additional limitations of geography where the resources are limited for studying crows.

   The total of quantities that are measurable or set of numbers is 'statistical population'. Thus, when only a single character symbolised every element of such a set then it is defined as 'single population', e.g., income of individuals. Depending on the finite and infinite number of elements, statistical population can be infinite as well as finite. A random set may not be a statistical population. **For example**, a set of crows at a point of time will not represent a statistical population.

3) **Sample:** A part of the population which is examined to estimate the characteristics of the population is called a sample.

   For example,

   i) A portion of rice is examined to assess the quality of rice in the bag where the portion of rice examined is the sample and the bag of rice is the population.

ii) From a large consignment, proportion of defective articles is estimated only from a portion of the consignment. The selected portion is called sample.

4) **Census:** When in a research every item or entity of the universe is included, that approach is called "census". In this method, detailed information regarding every population unit is collected. It is also called complete enumeration. This method provides more accuracy in the results in comparison to the sampling method.

For example, population survey about various issues, such as, literacy, education, income, etc., include all the items of the population.

Difference between Census and Sample

The differences between the census and sample are as follows:

Basis	Census	Sample
Meaning	When the whole population is targeted for collecting the relevant information about the members of population, it is called Census.	When a representative sample is prepared from the target population for collecting the relevant information, it is called Sampling.
Reliability of Data	Data obtained through census may be reliable and complete.	Data obtained through sampling is not fully reliable, it may have some error.
Time Taken	As it covers the entire population, it is time-taking process.	As it covers only few representatives of the population, it is not time-taking process.
Sampling Variance	There is presence of virtually zero sampling variance as the data used is taken from entire population.	Since the data used in sampling is taken from only few members of the population, sampling variance may be present.
Drawing of Data	In census, all elements of the population are processed to form data.	In sampling, only key representative elements of the population are processed to form data.
Applicability	Census may be applied to research including limited area.	Sampling may be applied to research including a large area.
Homogeneity	It may be useful for population having heterogeneous elements.	It may be useful for population having homogeneous elements.

5) **Sample Frame:** The actual set of units and a list containing every member of the population from which a sample is drawn at random is called sample frame. **For example,** if one wants to know the factors that are responsible for the patients being admitted in the hospital after an acute attack of asthma in a specified area, then it becomes necessary to know the names of all those people of that particular area being admitted into the hospital for that reason.

A good sampling frame should be:

i) **Relevant:** Research topic must be directly linked with relevant things.

ii) **Complete:** Coverage of all relevant items.

iii) **Precise:** It should exclude all the irrelevant items.

iv) **Up-to-Date:** Incorporating recent changes and additions, and deleting redundant items.

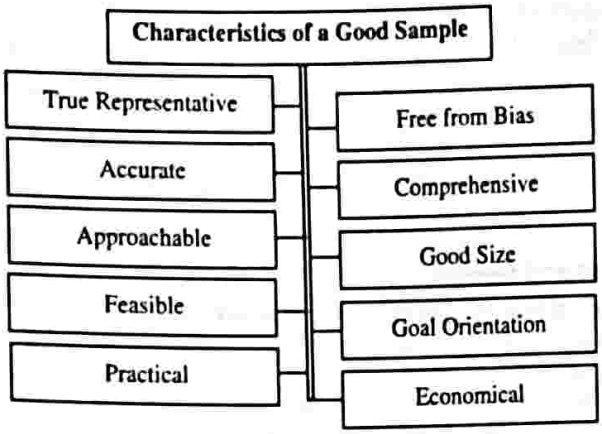
6) **Sample Unit:** Every sample is made up of several members or components. These members or components are called "sampling units". A sampling unit may or may not be a sampling element. Generally sampling unit is referred as sampling element. But in case of sampling units consisting of several population units, each sampling unit is called a cluster of units.

The individual population units which come under the cluster of units, are called sampling elements. Therefore in this case a sampling element is an individual object on which the research is done, and it is a component of sampling unit.

For example, in case of inspecting the quality of oranges, only few oranges are selected to examine and each selected orange is a sampling unit. But in case of finding the literacy level of a particular colony, several houses are selected in that colony for research. These houses are sampling units. However the individual members of each house are approached for examining the literacy level, thus these individual members of several houses are sampling elements.

3.9.3. Characteristics of a Good Sample

The various characteristics of a good sample design are as follows:



1) **True Representative:** The true representative of the population and matching its properties is termed as good sample where aggregate of certain properties is the population and sample is the sub-total of the universe.

2) **Free from Bias:** A good sample does not allows prejudices, pre-conceptions, and imaginations which affects its choice and it is unbiased.

3) **Accurate:** A sample is called good when it yields accurate estimates or statistics and free from errors.

4) **Comprehensive:** A sample that is true representative of the population is also comprehensive in nature which is controlled by definite purpose of investigation. A sample's characteristic may be comprehensive but it may not be a good representative of the population.

5) **Approachable:** The subjects of good sample are easily accessible where the tools of research are easily conducted and easy collection of data is possible.

6) **Good Size:** The size of good sample is such that it yields an accurate result and the error due to probability can be estimated.

7) **Feasible:** A good sample creates the research work more feasible.

8) **Goal Orientation:** Any sample which is selected by the researcher should be able to satisfy the objectives of the research. The sample should be taken in proper number. It should be customized to fit the environment under which the research is going to be conducted. If the sample is changed as per the requirement of the survey design then it can come out with better results and outcomes.

9) **Practical:** It means that the concepts of sample selection should be applied properly while conducting the research. The researcher should be well experienced and well instructed. The instructions which are passed to observer should be clear, complete and correct in all terms so as to avoid errors and biasness on their part. The sample should be selected on basis of the sample design. The sampling units should be representative. The sample design should be practical and feasible in nature.

10) **Economical:** It refers that the research should not incur huge costs, time or efforts. One of the objectives of any research is to complete the research with minimum effort, time, money and resources. The researcher calculates per unit cost for each respondent. The researcher should choose that sampling design which gives minimum per respondent cost and maximum accuracy. The funding agency is highly concerned with per unit cost and the corresponding accuracy.

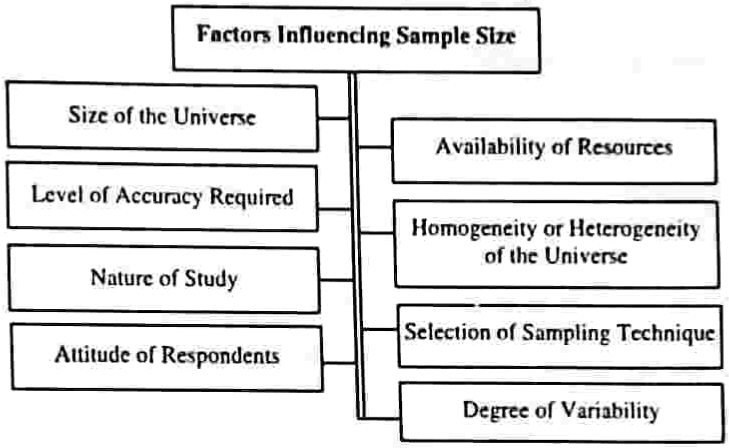
3.9.4. Sample Size

The sample size for a research refers to the total number of elements of the population to be included in the sample for conducting the research study. Both qualitative and quantitative points are involved in specifying the size of the sample for the research study. The accuracy of research depends on the size of the sample. It has been observed that a larger sample gives more accuracy and estimate levels. Apart from it, the availability of money, resources and efforts also specify the size of a sample.

The sample size of any research study is represented by 'n'. If the population is highly heterogeneous, then the sample will be divided into various groups with an indication that the sample size would be larger. If the population is homogenous then the sample will be small. Thus, at pre-assigned level there is a fixation of the sampling error and the standard error of the statistic, thus having sample size as 'n' is chosen

3.9.4.1. Factors Influencing Sample Size: Determinants of Optimal Sample Size

The following points should be taken care of while deciding the sample size:



1) **Size of Universe:** It has been observed and statistically proven that the sample size should be large so that it can represent the whole target population. If the universe size is large and heterogeneous then the researcher should take large sample size and vice versa.

2) **Availability of Resources:** The researcher needs a lot of resources to complete the task of research. These resources bind the researcher. It means that the researcher has to complete the research within those allotted resources. Resources can be money, time, experts or any other variable. If the resources are easily available than the sample size can be large otherwise smaller sample would be appropriate.

3) **Level of Accuracy Required:** For any research, the level of the accuracy affects sample size as bigger sample represents the whole population properly than a smaller sample. However, it is not always mandatory that a large sample will always give more accurate results. The selection of the sampling technique and research tools also impact the accuracy level of the research.

4) **Homogeneity or Heterogeneity of the Universe:** Homogenous universe is that universe in which all the elements are similar, on the other hand heterogeneous universe is that universe where the elements are different from each other. A homogeneous universe requires a smaller sample size, while researcher needs to take bigger sample size in case of heterogeneous universe because a small sample may not represent the whole population.

5) **Nature of Study:** The researcher may choose a small sample, if the research is intensive and fundamental (continuous) in nature. But in those cases, where the research is extensive and applied (researches which are not going to be repeated soon), then the researcher is bound to select a larger sample size. So, it is quite clear that the nature of study also affects the sample size.

6) **Selection of Sampling Technique:** The sample size is also impacted by the kind of sampling technique selected by the researcher for conducting the research. **For example**, when a researcher adopts the simple random sampling technique then he must choose large sample size, but on the other hand in stratified sampling technique the researcher needs a comparatively smaller sample size for accurate and effective results.

7) **Attitude of Respondents:** The researcher is an experienced individual, so he will always chose a larger sample size in which he thinks that the non-response rate will be higher. In simple words, if there are chances that the respondents will not reply and return the questionnaire, then large sample size is chosen.

8) **Degree of the Variability:** Degree of variability specifies the extent to which the scores in any distribution are spread in the population. Larger numbers always indicates greater variability of scores in a population. Sometimes dispersion is substituted for variability, and this term is widely used in statistics. If the population is heterogeneous, then the researcher uses larger sample size so as to receive a specified precision level. On the other hand, if the population is more homogeneous then the smaller sample size is selected by the researcher.

3.9.4.2. Determining Size of the Sample

The method of determination of optimal sample size has been discussed in two estimation problems:

1) Determination of sample size n when estimating the population mean.
2) Determination of sample size n when estimating the population proportion.

Determination of Sample Size (n) when Estimating the Population Mean

It is clear that, for large samples, unbiased estimator of population mean (μ) is sample mean ($\bar{X}$). The standar

error of ($\bar{X}$) is $\frac{\sigma}{\sqrt{n}}$. The following pre-assigned value is required for estimating the sample size:

1) The desired confidence level.
2) The permissible sampling error (E).
3) The population standard deviation (σ).

So, $E = \bar{x} - \mu$

and standard error of $\bar{X} = \frac{\sigma}{\sqrt{n}}$.

For large samples, $Z = \frac{\bar{X} - \mu}{\sigma / \sqrt{n}}$ Or $(\bar{X} - \mu) = Z\frac{\sigma}{\sqrt{n}}$

Suppose the desired confidence level is 95%. Then Z values defining 95% confidence level are ±1.96, thus

$$(\bar{X} - \mu) = \pm 1.96 \times \frac{\sigma}{\sqrt{n}} \quad \text{or} \quad E = \pm 1.96 \times \frac{\sigma}{\sqrt{n}}$$

$$\text{or} \quad \sqrt{n} = \pm \frac{1.96 \times \sigma}{E}$$

$$n = \left(\frac{1.96 \times \sigma}{E}\right)^2 \quad \text{or} \quad n = \left(\frac{Z\sigma}{E}\right)^2$$

Let's consider an example to explain this procedure. If a researcher wants to calculate the average income (i lac) of the given population having an accuracy of 0.5 of in income. This means that the researcher can tolera a loss of 50% in income on either side of the true average income at 95% confidence level. Thus, it means th the researcher wants to be 95% confident about his decision.

The formula for confidence limits is: $(\bar{X} - \mu) = Z\frac{\sigma}{\sqrt{n}}$

Where,

μ	=	Population mean
$\bar{X}$	=	Average income calculated from the sample
Z	=	Value of z at 95% confidence level
$\frac{\sigma}{\sqrt{n}}$	=	Standard error of $\bar{x}$
σ	=	Standard deviation
n	=	Sample size

If the researcher has decided to tolerate an error of 1/2 lac that is $(\bar{X} - \mu) = 0.5$

So $0.5 = Z\frac{\sigma}{\sqrt{n}}$ value of Z at 95% confidence level are ±1.96

So $0.5 = \pm 1.96\frac{\sigma}{\sqrt{n}}$ or $\sqrt{n} = \frac{1.96 \times \sigma}{0.5}$

The value of standard deviation (σ) can be calculated by either;

1) Assuming or guessing,
2) Consulting by the expert,
3) By experimenting to get the value, and
4) Obtaining σ from other comparable studies.

Let σ = 3 lac

Then, $\sqrt{n} = \frac{1.96 \times 3}{0.5} = 11.76$

$n = (11.76)^2 = 138.3 \approx 138$

Thus, 138 respondents are required to constitute a sample at 95% level of accuracy. Similarly, it can be calculated for 99% or others.

Example 1: the placement department of a leading management institution is planning a survey of annual earning of its MBA alumni numbering 2,000. How large a sample size it should take in order to estimate the mean annual earning within plus and minus ₹ 1,500 and at 95% confidence level? The standard deviation of annual earning of the entire population is known to be ₹ 2,500.

Solution: As the desired upper and lower limit is ₹ 1,500, i.e., we want to estimate the annual earning within ± 1,500.

$$\text{So } Z \times \frac{\sigma}{\sqrt{n}} = 1500$$

As the level of confidence is 95%, the Z value is 1.96

$$1.96 \times \frac{\sigma}{\sqrt{n}} = 1500;$$

$$\frac{\sigma}{\sqrt{n}} = \frac{1500}{1.96}; \quad \frac{\sigma}{\sqrt{n}} = 765.31;$$

$$\frac{2500}{\sqrt{n}} = 765.31; \qquad \sqrt{n} = \frac{2500}{765.31} = 3.3$$

So $n = 10.89$

Or $n = 11.$

Example 2: Lumber companies need to be able to estimate the amount of lumber that they can harvest in a tract of land to determine whether the effort will be profitable. To do so, they must estimate the mean diameter of the trees. It has been decided to estimate that parameter to be within one inch with 99% confidence. A forester familiar with the territory guesses that the diameters of the trees are normally distributed with a standard deviation of 6 inches. How large a sample should be taken?

(It is given that in a normally distributed population 99% area is covered within mean ± 2.57 standard deviations).

Solution: The forester determines the sample size as follows:
Error of Estimation (E) = 1

Confidence level is 99%, So Z = 1.96

The population standard deviation is assumed to be σ = 6.

Thus,

$$\text{Sample Size}\,(n) = \frac{Z^2\sigma^2}{E^2} = \frac{(1.96)^2(6)^2}{(1)^2} = \frac{36 \times 3.8416}{1} = 138.3 \approx 138$$

Example 3: A simple random sample is to be taken from a population of 50,000 sales invoices to estimate the mean amount per invoice. The standard deviation of the population is 4,000. The allowable error is 200 and the confidence coefficient is 90% (Z = 1.64). What size of sample is appropriate?

Solution: Given, Z = 1.64, $\sigma = 4000$ and E = 200

$$\therefore \quad n = \frac{Z^2\sigma^2}{E^2} = \frac{(1.64)^2 \times (4000)^2}{(200)^2} = 2.6896 \times 400 = 1075.84 \approx 1076$$

Example 4: Ascertain the size of the sample from the following particulars:
Standard deviation of population $\sigma_p = 4$

Mean of population $\mu = 24$
Mean of sample or $\bar{X}_s = 22$ and
Level of confidence = 99%
(Z value at 99% = 2.5758)

Solution: Given, Standard deviation of population (σ_p) = 4, Mean of population (μ) = 24, Mean of sample ($\bar{X}_s$) = 22 and Z = 2.5758.

Since, $\sigma_{\bar{x}} = \frac{\sigma_p}{\sqrt{n}}$

$$\Rightarrow \quad \sigma_{\bar{x}} = \frac{4}{\sqrt{n}}$$

$$\because \quad Z = \frac{\bar{X}_s - \mu}{\sigma_{\bar{x}}} = \frac{22-24}{4/\sqrt{n}}$$

$$\Rightarrow 2.5758 = \frac{-2}{4/\sqrt{n}};$$

$$\Rightarrow 2.5758 \times 4 = -2\sqrt{n}$$

$$\Rightarrow \sqrt{n} = -5.1516;$$

$$\Rightarrow n = 26.53 \approx 27$$

Determining Sample Size (n) When Estimating the Population Proportion

In the estimation of population proportion (p) sample proportion $\hat{p}$ is used for a sample of size n.

The standard error of $(\hat{p}) = \sqrt{\frac{pq}{n}}$ (p is known).

For large samples,

$$Z = \frac{\hat{p} - p}{S.E.(\hat{p})} = \frac{E}{\sqrt{\frac{pq}{n}}}$$

Where, $E = \hat{p} - p$ (sampling error)

$$\sqrt{n} = \frac{Z\sqrt{pq}}{E} \quad \text{Or} \quad n = \frac{Z^2 pq}{E^2}$$

Example 5: Suppose p is estimated as 60 % and the confidence level is set at 95%. If the allowable error in estimating the population proportion is not to be greater than 3%, calculate the required sample size.

Solution: At 95% confidence level Z = 1.96.

The sample size is given by $\sqrt{n} = \frac{Z\sqrt{pq}}{E}$

Here $p = 0.6, q = 0.4, E = 0.03$

So $$\sqrt{n} = \frac{1.96\sqrt{0.6 \times 0.4}}{0.03} = \frac{1.96\sqrt{0.24}}{0.03}$$

$$n = \frac{1.96 \times 1.96 \times 0.24}{0.0009} = \frac{0.921984}{0.0009} = 1024.43 \approx 1024$$

3.9.5. Sampling Plan/Procedure

A brief description of which measurements will be taken at what times, on which material, in what manner, and by whom, is termed as 'sampling plan'. The designing of the sampling plans should incorporate that data to be evaluated which is a representative sample of the parameters of interest and be answerable to all the questions as stated in the goals. Following are the steps involved in developing a sampling plan:

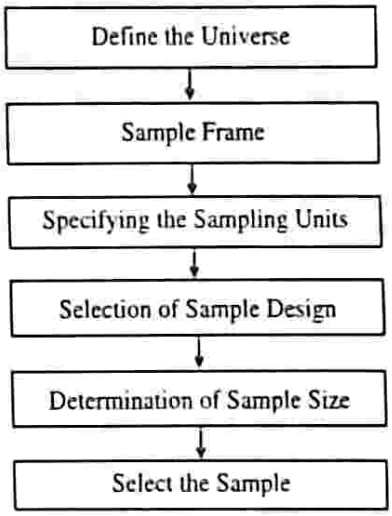


Figure 5.2: Sampling Procedure

1) **Define the Universe:** The universe can be restricted to some geographical limits, a particular type of product or some other constraints. Defining the universe is the initial problem in procedures of sampling. The collection of elements or objects possessing information desired by the researcher regarding what inferences are to be made is termed as the target population or the universe.

   Precise definition of the target population is must as ambiguous definition will result in ineffective research and deceptive in meaning. Proper defining of the target population requires translating the problem definition precisely as what should and should not be included in the sample.

   The description of the target population should be on the basis of elements, sampling units, the period and time. Thus, in survey research element is like an object from which or about which the information is required. In survey research, the elements are usually the respondents. **For example,** consider a marketing research project in which researcher wants to take response of the consumer for a new brand of men's perfume. It has to decide that who should be included in the target population. It is the important question that all the men included in the research or the men who used the perfume during the last month or men who are 17 years of age, or older. Should females be included, because some women buy colognes for their husbands? Appropriate description of target population requires prior resolution of such types of questions.

2) **Sample Frame:** The frame is enlisted by some population that already exists or it is constructed for some study to be conducted by the researcher.

   After the specification of the population to be studied, the frame of the population is developed. **Sampling frame** consists of all the sampling units of the population which is built by the researcher for the subject of his study or it consists of already existing list of the population. This frame does not consist of names only but it may include a permanent location, a boundary, an address, or the set of certain rules that describes a sampling unit.

   A set of boundaries which is restricting the universe is termed as a frame that may be in the form of lists, indices, maps, directories, population records, electoral rolls, city tax rolls, enrolment of the students in an university, etc. This frame is very mandatory in marketing studies and every element of the population enlisted appears only once which constitutes a sample frame. For a good sampling frame it should be accurate, free from duplication, and conveniently available. For the better performance of sampling procedure, sampling should be essential for marketing research. The representation of the elements of the target population is sampling frame which consists of a list or set of directions to identify the target population. **For example,** firms in industry that are enlisted in association directory, telephone book, a mailing list purchased from a commercial organisation, a city directory, or a map.

3) **Specifying the Sampling Units:** A sampling unit is decided on the basis of the sampling frame which is the primary unit containing the sampling elements of the population like, city blocks, households, a business organisation, etc. The design of the project is the partial basis of the selection of the sampling unit. The units that are served as initial sampling are called as primary sampling units. The objective of the inquiry is the basis of the composition of one or more units of the population.

For example, for the assessment of the consumer response to a new line of lipsticks, Lakme wants to sample females who are over 18 years of age where it can be the possibility of sampling such females directly and the sampling unit would be the same as an element. Otherwise, households might be the sampling units which are sampled. All the females above 18 in the selected households would be interviewed where the sampling unit differs from the population element. The time period under consideration is the extent of the geographical boundaries and the time factor.

4) **Selection of Sample Design:** The procedure of selecting units in the sample involves two primary methods of sampling namely, **probability and non-probability methods** that can be further sub-divided into specific methods of selection. The probability sample being one and the procedure involved in selecting the units has some specific chance of its inclusion in the sample. An arbitrary method is adopted in selecting the units which is not depending upon the chance for the non-probability sample. The purpose of inquiry and the attitude or convenience of the investigators is the basis of this method.

Two decisions are involved in the selection of the sample design:
i) To use probability or non-probability method of selection, and
ii) Specific sample design to use in collecting the data.

The following considerations affect the choice of the researcher:
i) Usage of the probability sampling for the evaluation of the sampling error.
ii) Probability sample should be used for ensuring randomness in the selection of the units.
iii) Non-probability sampling should be used in the absence of proper sample frame.
iv) Non-probability sampling should be used when the considerations of time and money are important.

To achieve the objectives of investigation in the best possible way sample design should be selected after the decision of the method of selection whether probability or non-probability method. Unconcerned about the design being chosen finally the researcher has to defend his design at the time of the final presentation of the study results.

5) **Determination of Sample Size:** The desired degree of accuracy in investigation is directly proportional to the size of the sample which also depends upon the nature of the population and the method of selection. The ideal sample size in marketing research investigations depends upon the type of series and the population size. There will be more degree of heterogeneity and larger units will be drawn in the sample due to larger size of the population. Hence the size of the sample should be larger for being fully representative.

6) **Select the Sample:** Execution of the actual sampling process is called as selection of the sample and the real selection of the elements of sample requiring considerable amount of office and field work especially when the personal interviews are involved. Detailed specification of the sampling design is the requirement for the execution of the sampling process with respect to the implementation of the size of population, sampling frame, sampling unit, sampling technique, and sample size. Sampling units being the household's requirement is the operational definition of a household, procedure for those houses that are vacant and if nobody is at home then the execution of the call backs is mandatory. For all the sampling design, decisions information must be provided in detail.

3.9.6. Advantages of Sampling

Following are the advantages of sampling:

1) **Saves Time, Money and Effort:** The subjects involved in sampling are small in number which gives him less time to calculate, tabulate, present, analyse, and interpret and hence the researcher saves time, money and effort.

2) **More Effective:** Due to the size of the sample being small than that of the population, the tiredness is reduced in collecting the information and investigator works more effectively.

3) **Faster and Cheaper:** Due to small sample size the data collection, tabulation, presentation, analysis, and interpretation takes less time and it involves nominal expenses.

4) **More Accurate:** Small errors are in sampling because small data are involved in collection, tabulation, presentation, analysis and interpretation.

5) **Gives More Comprehensive Information:** Thorough investigation of the study is the result of small sample which provides more complete information as all the members of the population have equal chance to be included in the sample.

3.9.7. Disadvantages of Sampling

Following are the disadvantages of sampling:

1) **Biased Selection:** Biased selection of the respondents may be included in sampling by the research worker.

2) **Difficulty in Selection:** It is very difficult to select a truly representative sample because a large number of factors obstructing the method of selecting good samples.

3) **Specialised Knowledge Needed:** Specialised knowledge is required in the sampling method where the investigator may commit serious mistakes due to its absence.

4) **Problem of Cooperation:** Due to scattered sample the subjects are uncooperative with the researcher.

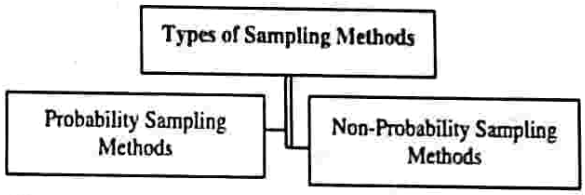
5) **Less Accuracy:** When the higher standard of accuracy is expected then the sampling is not suitable.

6) **Limited Nature:** Due to small or dissimilar universe it is impossible to derive a representative sample where census study is the best possible substitute.

3.10. SAMPLING TECHNIQUES/METHODS

3.10.1. Introduction

Thus, sampling methods are basically of two types, viz., **probability sampling** and **non-probability sampling** as shown in **figure below:**



3.10.2. Probability Sampling Methods

The method, in which all units of the universe are given equal chance of being selected in the sample, is known as Probability Sampling. There is an assurance of the results in terms of probability that are obtained through probability or random sampling. The significance of the results lies in measuring the errors of estimation obtained from a random sample which brings predominance of the random sampling designs over the intentional sample design.

The various probability sampling methods are as follows:

1) **Simple Random Sampling:** This is the most famous and simple method of sampling where each unit of the population is equally probable of getting included in the sample. Let us consider that the size of the population is 'N' from which n units are to be selected at random for a sample such that ${}^{N}C_{n}$ sample has the probability of being selected equally. Simple random sampling says that:
   i) There is an equal chance for each element of the population to be included in the sample and the choices are independent to each other.
   ii) Each possible sample combination has an equal chance of being chosen.

   The possibility of bias or personal prejudices in the selection of the units is eliminated by the method of simple random sampling.

2) **Systematic Sampling:** After the selection of one unit at random from the universe the other units are selected systematically at a specified interval of time. This method is applicable when the size of the population is finite and on the basis of any system the units of the universe are arranged such as alphabetic arrangement, numerical arrangement, or geographical arrangements.

3) **Stratified Random Sampling:** In the Stratified Random Sampling, the sample is selected from different homogeneous strata or parts of a universe instead of heterogeneous universe as a whole.

   The summary of this sampling procedure is as follows:
   i) The sampled universe is divided (or stratified) into groups that are mutually exclusive and include all items in the universe.
   ii) A simple random sample is then chosen independently from each group or stratum.

There is a difference in the process of stratified random sampling from that of simple random sampling. In simple random sampling the sample items are chosen at random from the whole universe whereas in stratified sampling the design of the sample is the selection of the separate random sample from each stratum. The distribution of the sample among strata is based on chance in simple random sampling.

Formally, divide the population into non-overlapping groups (i.e., strata)

$N_1, N_2, \ldots\ldots\ldots\ldots N_i$

Such that $N_1 + N_2 + \ldots\ldots\ldots\ldots + N_i = N$

Then randomly choosing a sample of $f = \frac{n}{N}$ in each stratum, where f is the sampling fraction.

4) **Cluster Sampling:** According to this method there is further noticeable sub-division of the universe into clusters. Simple random sampling is performed and clusters are drawn accordingly constituting a sample of all the units belonging to the selected clusters. **For example,** if we have to conduct a survey in the city of Mumbai, then the city may be divided into, say, 40 blocks and out of these 40 blocks, 5 blocks can be picked up by random sampling and the people in these five blocks are interviewed to give their opinion on a particular issue. The clusters chosen should be small in size, i.e., more or less the same number of sample units should be there in each cluster. This method is used in the collection of data about some common traits of the population.

5) **Multi-Stage Sampling:** Modification of cluster sampling is multi-stage sampling where in cluster sampling, a sample is constituted by all the units selected in a cluster but in multi-stage sampling the selection of the sample units is in two, three, four stages. Firstly, the universe is divided into first-stage sample units and then further sub-divided into second stage units out of which another sample is selected and similarly third and fourth stage sampling is performed in the same way. **For example,** in an urban survey first stage sampling will be of selection of towns and then for each selected towns households will be taken as sub-sample and depending upon the need, individuals will be selected as samples of third-stage sampling.

6) **Area Sampling:** The area sampling is a form of multi-stage sampling in which maps instead of lists or registers is used as 'sampling frame'. It is commonly used in those countries which do not have proper sampling frame like a population list. For geographic sub-divisions, 'clusters sampling' is the other name of 'area sampling'. The cluster of units based on geographical area is the primary sampling units known as 'cluster designs' which are famous as area sampling. The positive and negative features of cluster sampling are also applicable to area sampling.

3.10.2.1. Merits of Probability Sampling

Following are the merits of probability sampling:

1) **Unbiased Estimates:** The sampling method which basically provides unbiased estimates are called random sampling, having significant precision. If this level of objectivity is required by the investigator, then some alternative probability sampling is important.

2) **Relative Efficiency:** Evaluation in quantitative terms of the relative efficiency of other sampling techniques under a given situation by the researcher is permitted by random sampling which is normally impossible in non-probability sampling.

3) **Less Universe Knowledge Required:** Comparatively, little knowledge of universe is required. Basically, two things are required to be known only:
   i) A unique way of identifying each universe element, and
   ii) The total number of universe elements.

4) **Fair:** Every item in the population has an equal chance of being selected and analysed.

5) **Easy:** Easy data analysis and error calculation is allowed by this method of sampling.

3.10.2.2. Demerits of Probability Sampling

The demerits of probability sampling are as follows:

1) **Less Efficient:** Other sampling methods are more statistically efficient in comparison to this method.

2) **Non-Utilisation of Additional Knowledge:** No additional knowledge is used in this method about how the population is organised.

3) **Complex and Time Consuming:** In many cases, this method of selection is time consuming and complicated, particularly for marketing research in which the budget constraints and limitations of time provide preference to non-probability methods of sampling.

4) **High Level Skills:** A very high level of skill and experience is required for using probability sampling.

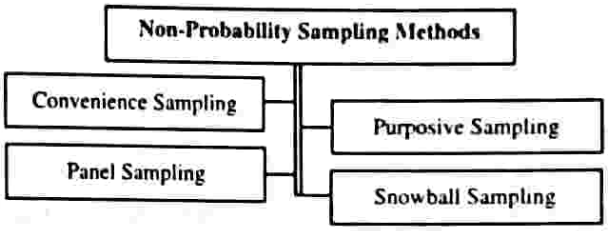
5) **More Time Required:** For planning and execution of a probability sample a lot of time is required.

6) **High Costs:** In comparison to non-probability sampling, probability sampling involves higher cost.

3.10.3. Non-Probability Sampling Methods

Non-probability sampling is that type of sampling procedure which does not have any ground for estimating the probability that whether or not each item in the population has been included in the sample. There are different names of non-probability sampling such as deliberate sampling, purposive sampling and judgement sampling. In this type of sampling, the researcher deliberately selects items for the sample and the choice of researcher regarding the item is provided more weightage.

In other words, under non-probability sampling the organiser of the inquiry purposively chooses specific units of the universe to constitute a sample on the basis that the small portion selected by him, out of a huge one is typical or representative of the whole universe. The various non- probability sampling designs are:



1) **Convenience Sampling:** On the basis of convenience and approachability, the choice of the sampling units by the researcher, is known as 'convenience sampling'. Samples that are selected accidentally are called 'accidental samples'. Because of the selection procedure (units are selected from their actual place) it is called as 'sample of the man in the street'. Due to their accessibility, samples units are selected. **For example**, by adding the new product in the nearby suitable shops, the potential of the product is tested. This is accomplished by observing the purchasing and selling report of the product.

2) **Purposive Sampling:** A non-probability sample which follows certain norms is called purposive sampling. Purposive sampling is basically of two types:
   i) **Judgement Sampling:** The study which is based on the parameters of population, where the units are selected by a researcher or some other expert on his /her judgement, is called 'judgement sampling'. This technique of sampling is appropriate in the situation where the study of the population is difficult to locate or there are members who are comparatively better than others for an interview in terms of knowledge or interest.

   ii) **Quota Sampling:** Quota sampling is the most commonly used non-probability sample designs, which is most comprehensively used in consumer surveys. Principle of stratification is also used by this sampling method. In stratified random sampling the researcher begins by building strata. The common bases for stratification in consumer surveys are demographic, e.g., age, gender, income and so on. Compound stratification is generally used, e.g., gender-wise age groups.

3) **Panel Sampling:** In panel sampling a group of participants are selected initially by random sampling method and the same group is asked for the same information repeated number of times during that period of time. This sample is semi-permanent where members are included repeatedly for iterative studies. In this sampling, there is a facility of selecting and contacting samples that fit in getting high response rate, even by mail.

4) **Snowball Sampling:** When the characteristic of the desired sample is limited then the special non-probability method is applicable. In this method, it is difficult to locate the respondents because it will be very costly. Depending on the referrals of the initial subjects snowball sampling generates additional subjects. Though this technique is biased and unable to represent a good cross-section from the population but dramatically it reduces the search cost.

3.10.3.1. Merits of Non-Probability Sampling

1) **True Universe Picture:** Relevant sections of the universe may be selected in the proportions they appear in the universe.
2) **Economical:** Geographical concentration can be achieved thus reducing costs.
3) **Quick:** Useful and quick method in certain circumstances.
4) **Specific Cases Types:** This can be the only technique available for some special cases such as illegal drug users.
5) **Specific Members of Population:** Helpful, if researchers are truly interested in specific members of a population, not the entire population.
6) **Pilot Study:** Acts as an exploratory research like a pilot study, attempting to determine whether a problem exists or not.

3.10.3.2. Demerits of Non-Probability Sampling

1) **Details Needed:** Detailed initial information of the universe is needed.
2) **Errors:** Errors in sample selection can easily occur.
3) **Subjective Nature:** The subjectivity of non-probability sampling prevents making inferences to the entire population.
4) **Selection Bias:** Validity and credibility are questionable due to selection bias.
5) **Reliability:** The reliability of the resulting estimates cannot be evaluated which results in the user not knowing how much confidence can be placed in any interpretations of the survey finding.

3.10.4. Probability Versus Non-Probability Sampling Methods

Basis	Probability Sampling	Non-Probability Sampling
1) Control	Sampling error can be controlled in probability sampling.	Sampling error cannot be controlled in non-probability sampling.
2) Chances of Selection Bias	The selection process is not influenced by the expertise of the researcher because it depends on the specific technique.	There may be existence of higher level selection biasness.
3) Economy	The involvement of time and costs may be high.	The involvement of cost is very low and quicker alternative.
4) Reliability	Possibility of testing the hypotheses through formal, rigorous tests of significance in obtaining more reliable results.	The reliability of results is not very high because parametric tests of significance are not applicable.
5) Suitability	If the population is heterogeneous then it is more reliable and representative.	For homogeneous population it may be more useful.
6) Usefulness	If complex, detailed estimates is required then it may be preferable.	If parameters to be estimated are at broad, aggregated levels, such as market shares or total sales, it may be used reasonably.
7) Degree of Accuracy	If the population is high then the accuracy may be poor.	Accuracy in such situations may be scattered.
8) Sampling Frame	In probability sampling formal sampling frames are required.	It is effective even in the absence of an elaborate sampling frame.
9) Convenience	If the cheaper geographical spread of the population is high and likely to have lower then it may be very inconvenient.	More convenient, less time-consuming, non-sampling errors.
10) Example	A researcher wants to understand more about the career goals of students at a single university. Let us say that the university has roughly 10,000 students. These 10,000 students are our population (N). Each of the 10,000 students is known as a unit (although sometimes other terms are used to describe a unit). In order to select a sample (n) of students from this population of 10,000 students, we could choose to use simple random sampling, systematic random sampling and stratified random sampling.	Using a sample of people in the paid labour force to analyse the effect of education on earnings is to use a non-probability sample of persons who could be in the paid labour force. Because the education people obtain could determine their likelihood of being in the paid labour force, technically the sample in the paid labour force is a nonprobability sample for the question at issue. In such cases results are biased.

3.11. EXERCISE

3.11.1. Short Answer Type Questions

1) What do you mean by data collection?
2) What is the difference between primary and secondary data?
3) State the different methods of primary data collection.
4) What is a questionnaire?
5) Define structured questionnaire.
6) What is disguised and undisguised observation?
7) Explain survey method.
8) Enumerate the difference between survey and observation.
9) State the significance of consumer survey.
10) Define sampling.
11) What is the difference between census and sampling method?
12) How sampling size can be determined?
13) What do you mean by stratified random sampling?

3.11.2. Long Answer Type Questions

1) What are the different methods employed in collecting research data? State the precautions required to be taken in collection of data.
2) Does primary data have any significance in research process? What are the limitations of collecting data directly from market?
3) Discuss the steps involved in construction of questionnaire and instrument.
4) State the various precautions that need to be taken while framing a questionnaire.
5) What do you mean by observation? Enumerate the significance and limitations of observation method.
6) What are the different methods of doing survey? State the limitations of survey method.
7) Explain the different modes of conducting interview. State the drawbacks/limitations of this method.
8) Define secondary data. What are the different methods of collecting secondary data
9) What do you mean by sampling size? Highlight the determinants of optimal sample size.
10) Illustrate the different sampling techniques, stating their merits and demerits.
11) Differentiate between probability and non-probability sampling.
12) Write short notes on:
    i) Validation of questionnaire
    ii) Sampling plan

UNIT 4

Data Preparation and Analysis

4.1. DATA PREPARATION AND PROCESSING

4.1.1. Introduction

Once, the data has been collected, it has to be processed and reduced so that it can be analysed by the researcher. The data which is collected through a study is usually in a raw form. This form of data often has errors and inconsistencies which are not relevant for the study. This raw data has to be transformed into a relevant set by the researcher through the process of editing, coding and tabulation. This stage is very important for effective research work, as processing the data reduces the errors and biasness, resulting in relevant and specific data which is appropriate for analysis.

Data preparation and processing is the primary stage of data analysis. It refers to setting-up the collected data in such a format that it can be appropriately coded and analysed through computer. Without processing the data, it cannot be evaluated and communicated.

While processing the data, the researcher simplifies, conceptualises, and transforms the selected data into a proper form as per the research objectives. This refining of data continues throughout the research process. Processing of data should be done in such a way that it gives the appropriate analytical outcomes, and the integrity of the original data is also maintained.

The raw data obtained from the questionnaires must undergo preliminary preparation before they can be analysed using statistical techniques. The quality of the results obtained from the statistical techniques and their subsequent interpretation depends to a great degree on how well the data was prepared and converted into a form suitable for analysis.

4.1.2. Significance of Data Processing

Significance of data processing can be understood with the help of following points:

1) **Provides Accurate Data:** In data processing, a researcher checks the accuracy of the data. As a result, if data processing is done properly, all chances of errors in collected data are eliminated. It also ensures that the quality of the data is maintained by rectifying all the errors and omissions after the data is processed.

2) **Provides Comprehensive Data:** After going through data processing, the raw data transforms into meaningful information that can be better understood by the researcher and in turn can be analysed in an efficient way.

3) **Converts in a Suitable Format:** Data processing increases the efficiency of data by transforming it into a suitable format that is computer readable as well as comprehensive, due to which the analysis can be performed in less time.

4) **Helps in Decision-Making:** Processing the data also helps in decision-making. Data processing operations transform the raw data into relevant information, which helps the managers to make important decisions and take necessary actions.

5) **Provides Comprehensive Data:** Data processing makes the raw data concise, easy to read, and presentable. It becomes easy for the managers to comprehend the data if the data is processed, as it takes less time.

4.1.3. Data Processing Operations

Data processing converts the raw and unorganised data into meaningful and organised information. Raw data can be in any form and structure which may not be useful for research. The solution to this problem is processing the data in various steps to make it more relevant and meaningful.

Various operations in data processing are as follows:

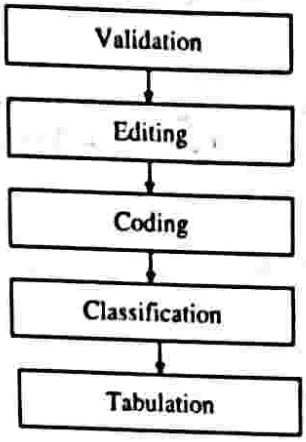


Figure 4.1: Data Processing Operations

4.1.4. Data Validation/Validity of Data

Validation is the process of examining the degree of validity and accuracy in the process of surveys, interviews and observations. It also checks whether or not these processes have been carried-out without any biasness and errors. During the process of data collection, it is not always possible and easy to scrutinise the data so that their accuracy can be checked. Although minute details are not included in the analysis of data, but these play a vital role in validating data. It is the process which includes detailed inspection of the collected data to confirm its optimum quality standards. Then it converts raw data into validated data which are then processed to make the summary reports.

Data validation is a complicated process which includes closely monitoring the data and the methods of data collection. Sometimes, the most critical concerns of the marketing researcher are the errors in survey data, provided by their employed research agencies. Each research project must be protected from the hurried and hustled data collection activities. This makes the data validation an important and vital step of research process.

4.1.4.1. Phases of Data Validation

Data validation is carried-out in following two stages/phases:

1) **Field Validation:** Field validation is the activity where the researcher monitors and checks the validity of data at the time of data collection, i.e., during fieldwork. Some of the aspects that are necessary to consider in this step are as follows:
   i) **Data Collection Process:** The foremost consideration is to thoroughly carry-out the data collection process. During interviews, the data is collected simultaneous to the interviews. Therefore, the validation of data should also be carried-out at the same time. Here, researchers should strive to check whether both the interviewers and interviewee have followed the process of collecting data in a specified manner or not. **For example**, if a research requires to interview fifty unauthorised retailers of garments, then it is essential on the part of researcher to determine whether the retail shop is authorised or not before taking the interview. If this is not followed, then the outcome may get affected.
   ii) **Proper Screening:** Another important factor to be considered is screening of data as per the set criteria. **For example**, if a research requires demographic details of the families having annual income less than ₹1,00,000 then avoiding this criterion may cause errors to arise and may disrupt the outcomes.
   iii) **Fraud:** Another factor that needs to be checked is fraudulence, which is one of the most difficult aspects to determine. At times, the interviewers or researchers fill-up the data themselves so as to complete the questionnaire, which makes the data false and deceitful. This form of fraudulence occurs when the respondents are facing time and cost constraints. Another form of fraudulence may occur when researchers bribe the respondents during the survey or interview process.

2) **Validation within the Firm:** As soon as the field validation is completed, the researcher moves on to the next stage, i.e., validation within the firm. It becomes the prime responsibility of the research agencies or the firm conducting researches to validate and analyse the data within the firm.

Some of the aspects that are needed to consider while validating data within the firm are as follows:

i) **Data Completeness:** At the time of data collection, the researchers mistakenly skip questions or even the respondents may have avoided answering the questions. This results into collection of incomplete data. The small or minute data that has been left incomplete is of no use to the firm. Hence, this data should be eliminated. **For example**, if a research study requires getting the details regarding households having annual income of ₹2-3 lacs and their investment patterns, then the minute details regarding their households can be ignored and removed if remained incomplete or missing. The reason to eliminate incomplete data is that if incomplete or missing information is projected for further analysis, then the outcomes are sure to be erroneous.

ii) **Data Usability:** One of the responsibilities of the researcher is to determine whether the quality of data is sufficient for the purpose of analytical process or not. It is also required to be checked whether the available data is reliable and can support the conclusions or not. Hence, only that data which is reliable, of sufficient quality, and can support the analysis, should be kept.

4.1.4.2. Guidelines for Data Validation

Some guidelines for data validation are as follows:

1) **Cross-Check:** The respondents who have filled the questionnaire or have been interviewed should be interrogated again to cross-check the reliability of their responses. The researchers should ask some of the questions to which they have already answered and should be asked to comment on specified issue to monitor the consistency of their answers.

2) **Review the Questionnaire and Instructions:** The questionnaire or interview details should be examined to ensure that the answers given by the respondents match with the sample needs. If the interviewer was asked to take the interview of women aged between 30 to 35 years, but the data classification shows that the respondent's age as 40 years and gender as male, then it is very likely that the details are erroneous and faulty.

3) **Determine Sampling Errors:** Every single call sheet of the interviewers is analysed to ensure that the conducted interview was as per the accurate sampling procedures.

4.1.5. Data Editing

This is the second step in data processing. Raw data is subjected to many errors and omissions which can occur during the data collection process. In editing, these errors are corrected so that readers do not get confused or misled. Editing converts the raw data into a presentable format, so that further analysis and interpretations can be done efficiently.

Editing basically comprises of inspecting, correcting, and modifying the unorganised data so that the data become relevant and meaningful. This in turn reduces the confusion which can arise from wrong and inaccurate data. It ensures that there are no omissions and errors, and the data is in a readable form, which helps in maintaining the flow of information throughout the process of research.

4.1.5.1. Essentials of Editing

Editing should be done keeping the following essentials in mind:

1) **Completeness:** For effective editing, it should be considered that there are no omissions. Therefore, it is essential that all the questions have been asked and the corresponding responses have been recorded respectively. In case, any data is missing, the researcher either can deduce the missing data based on other data in the questionnaire, or can fill the data by recalling it.

2) **Accuracy:** Data editing should be done keeping in mind, that the data recorded should be accurate. Researchers must check the reliability of answers during the data collection itself, which is not possible every time. Accuracy of the responses can be estimated with the help of 'check questions' included in the questionnaire specifically for important data. 'Check questions' can either directly estimate the ambiguity

of the response, or can help the researcher to deduce the correct responses. Researchers can also conclude the response with the help of other related questions in the questionnaire. Sometimes, researchers can also contact the respondents again to get the correct response.

3) **Consistency:** An important consideration while editing the data is, maintaining consistency in responses. It should be checked that answers are given in the same manner the questions have been asked. In other words, all the responses for a question should be answered in a similar way by all respondents. Since, the inappropriate and inadequate answers create confusion and wrong interpretation; hence the researchers should make sure that the responses lead to proper conclusions.

4.1.5.2. Stages of Editing

Data editing can be performed in two stages:

1) **Field Editing:** Field editing is performed during the data collection. All the responses collected are checked for errors and omissions. While, collecting the data, the researchers instantly check for accuracy, uniformity and completeness of the answers.

   Field editing can be done in two ways:

   i) **By the Researcher:** Due to shortage of time, researchers while taking interviews, note down the responses in the form of symbols or short notes. After completion of the interview, researcher reviews the answers, corrects them if necessary, and completes the questionnaire by specifying the answers to each question.

   ii) **By the Supervisor:** Another form of field editing is done by the supervisor of the team of interviewers appointed for collecting the data from a sample of respondents. The supervisor maintains quality of data by ensuring that all interviewers complete their task honestly. This is done by checking and reviewing the responses of the interviews and correcting the errors at the first stage itself.

2) **Office/Central Editing:** When all completed forms are brought at the central office, an individual or a team of individuals performs the editing activities on these forms. This process is called 'office editing' or 'central editing'. Office editing is much accurate than field editing. It is more suitable for mail surveys as field editing cannot be performed in this case, unlike the questionnaires and interview schedules.

4.1.5.3. Handling Unsatisfactory Responses and Missing Values

The data gathered from the questionnaires should be clear and legible so that process of data coding can be carried-out properly. Many times responses made by the respondents are not clear when not recorded in a proper way. Illegible responses are quite common in questionnaire having several unstructured questions. The researcher may also face problems like incomplete responses and unanswered questions while analysing the recorded data.

Here the researcher conducts a basic screening for inconsistency in the answered questions. **For example,** a respondent has an annual income of ₹3,00,000 yet while answering the question regarding frequently purchased clothing brand he/she selects high-end brands like Gucci, Armani, Dior, Prada, etc.

The researcher faces many difficulties in interpreting the responses made while answering unstructured questions. Answers to unstructured questions may contain some ambiguous words or may be in abbreviated form. Problems may also occur while checking responses made while answering structured questions, as sometimes the respondents tick on more than one options while answering a single response question.

Treatment of Unsatisfactory Responses and Missing Values

There are three methods for handling unsatisfactory responses. They are discussed below:

1) **Returning to the Field:** Here the questionnaires that have unsatisfactory responses are likely to be returned to the field. Here the respondents who had given unsatisfactory responses are re-contacted by the interviewer. This method is popularly used in industrial or business marketing surveys, as the respondents can be identified with ease and the sample size in small. This method may not give accurate results as the data collected during the second interview may not be consistent with the first interview data. The variations in responses may be due to changes in time, mode of interview, mental status of the respondents, etc.

2) **Assigning Missing Values:** This method is used by the editor when returning to the field is not feasible. This approach can be adopted when:
   i) There are only a small number of respondents with unsatisfactory responses, or
   ii) Each respondent has a small proportion of unsatisfactory responses, or
   iii) Unsatisfactory responses do not involve any key variables.

3) **Discarding Unsatisfactory Respondents:** This method discards the unsatisfactory responses. This approach may be applicable when:
   i) There are less than 10 per cent of unsatisfactory respondents,
   ii) The study has a large sample size,
   iii) There is no difference between unsatisfactory respondents and satisfactory respondents in terms of product usage characteristics, demographics, behavioural attributes, etc.,
   iv) Responses on key variables are missing, or
   v) Each of these respondents has a large proportion of unsatisfactory responses.

4.1.6. Coding

Coding is the process of converting the data into meaningful categories and then assigning symbols to each of these categories. These symbols are known as codes. The categories are formulated in such a way that these are mutually exclusive, i.e., an answer should belong to a single class only. The categories should also have the exhaustiveness, which refers that all the questions must be assigned to certain class and none of them should be left uncategorised. The classes or categories should be uni-dimensional which implies that a category should contain same or similar responses.

For example, while coding the responses the researcher assigns a code '1' to all male respondents and '2' to all the female respondents. It can be seen that this process reduces the entire data of responses into two mutually exclusive classes of 'Male' and 'Female'. Also the logic that governs the assigning of a code to a data is uniform i.e. 'Gender'.

Coding is done to limit the data into a smaller set of finite classes. These can then be tabulated and analysed. These classes are homogenous in nature. For coding, it is essential to edit the data first, as from the raw data, it would be very difficult to conclude meaning.

Coding includes three basic activities, *viz.*, formulating the categories, allocating answers in those categories, and finally assigning codes to those categories. Since, the responses are reduced to limited categories, it becomes easy to analyse data. The decisions regarding the categorisation should be made during constructing the questionnaire to make the data collection easy and effective.

4.1.6.1. Principles of Coding

Coding should be done keeping in mind the following essential principles:

1) **Relevance:** This principle of coding implies that a coding class should be constructed according to the objective of the study that is being undertaken. The categories should be able to contain the data necessary to test hypothesis else formulating categories would become useless.

2) **Exhaustiveness:** This principle states that all raw data should belong to some particular categories. In other words, no data should remain uncategorised in the classes created by the researcher. Researchers often include categories like "Other" to capture data which does not fit in any of the pre-formulated categories.

   Sometimes, it is possible that new data is entered at later stages of research. In this case, the categories should be able to include the new data also. If maximum data are representing the 'other' category, then there is an error in the categorisation process. It can be problematic especially in case of objective type questions.

3) **Mutual Exclusiveness:** This means that a data point should belong to one class only. In other words, none of the classes should have any item in common. **For example**, if a question is asked – "Which games do you play – Cricket, Football, Badminton or Chess" Many respondents will choose more than 2 options from these. Hence while coding the responses the data will not be mutually exclusive. This problem can be solved by providing operational definitions.

One of the functions of operational definition is to define categories that are made for mutually exclusive elements. In this case operational definitions of the games can be classified under "indoor game" and "outdoor game" which will clarify the responses.

To specify the categories in a better way, the operational definitions should be written alongwith the categories. It clarifies the situation and reduces the confusion about categorising.

4) **Uni-Dimensional:** This principle implies that there should be a single concept for a class. In other words, a category should be defined using a single dimension only. If a category is defined in terms of more than one dimension, then it will not remain mutually exclusive, unless the cells are defined using a combined dimension.

For example, if a data set defines the occupations as manager, salesman, teacher, engineer, and artist, then locating the unemployed teacher in defined categories is difficult. Hence, it can be located if the categories are defined with combined dimensions like employed teacher, unemployed teacher, employed engineer, etc.

4.1.6.2. Procedure of Coding

Coding is done through the following stages:

1) **Identifying Open Coding:** In this stage, the researcher tries to identify the possible open categories to locate the data. Formulating the open categories is done by constantly comparing the data to incidents and incidents to categories till an optimum limit is reached. Generally, the researchers prefer maximum 10 categories, but the number of categories depends upon the information needed to be explored, based upon the research objective.

2) **Axial Coding:** Once, the open category formation has been completed, the researcher moves on to the next stage, i.e., axial coding. In this stage, a coding paradigm is developed. This is done by choosing a particular category, out of the possible open categories, as a 'core category'. Now, the researcher reviews various aspects of data collection and then forms some categories related to the core category. He tries to identify the phenomenon, the causal factors, the intervening variables, the strategies and the potential limiting factors. This complete information is displayed with the help of blocks and arrows which then helps to develop the coding paradigm.

3) **Selective Coding:** The final stage of coding process is selective coding. In this stage, the researcher develops a theory regarding the coding process by inter-relating the coding categories presented in coding paradigm. The paradigm is refined and presented as a model or theory of the complete process. This theory or model includes propositions that indicate the possible concepts to be explored and tested in future.

4.1.7. Classification/Categorisation

Classification is the process of creating the homogeneous classes into which the edited and coded data can be grouped on the basis of their common characteristics. By classifying the data in different groups, meaningful results can be extracted. The complete data set is divided into predefined groups in such a way that none of the data is left unclassified.

For example, a researcher can classify a group of 100 respondents into smokers (60) and non-smokers (40). By analysing this classification, it can be noticed that all respondents in the respective categories are either smokers or non-smokers, and hence are homogenous in the sense that they share the habit of smoking or non-smoking.

4.1.7.1. Principles in Classification of Data

Given principles should be followed for effective classification of data:

1) **Unambiguous Classification:** Classifying the data should reduce the ambiguity. This objective can be achieved by formulating the classes that are homogeneous in nature based upon the common characteristics of data. The categories should be defined clearly, so that they do not confuse or mislead the researcher. **For example**, in the classification of smoking habit, formulating only two classes of 'smoker' and 'non-smoker' can confuse the researchers to locate the habit of 'occasional smoker'.

2) **Single Classification Principle:** In classification, a class should be defined based on single dimension at a time. If more than one dimension is taken into account for one category, it may lead to confusion. Hence, it

should be kept in mind that a category should contain only one dimension. This helps the researchers to analyse and interpret easily. **For example**, population can be characterised by many dimensions, such as age, geographic area, gender, occupation, religion, etc. Here, different categories should be formulated for each dimension, such as, age, geographic area, gender, etc., respectively.

3) **Mutually Exclusive Categories:** Each data should belong to one class only. There should be no data which belongs to more than one class.

4) **Mutually Exhaustive Categories:** The entire data should be covered in the defined classification categories. No data should be left out in the classification process and none of the responses should be omitted during classification.

5) **Action-Oriented:** Classification of data should be carried-out based on the objectives of the research. Therefore, it implies that classification of data and the number of classes to be formulated are based on the objective of the research under study.

6) **Distinctive Categories:** Sub-categories in a classification should also be distinctive and different enough from each other so that they are suitable for different set of problems.

7) **Relevant for Research Project:** Classification should be done with the aim of studying and analysing the research problem more accurately, as the classification done without any objective will be useless for the research.

4.1.7.2. Types of Classification

Classification is of the following types:

1) **Classification According to Attributes:** Here the classification is done on basis of some common descriptive characteristics or attributes. These are qualitative in nature, as they cannot be measured, but their existence can be observed clearly. The examples of these attributes are beauty, honesty, truthfulness, etc. The data obtained through this classification is called "statistics of attributes".

   Classification by attributes can be done using either one attribute or more than one attribute. In the former case, the classification is done on the basis of one attribute and only two categories are created, one for the data having that attribute and the other that does not have that attribute. This is called "simple classification". In the latter case, the researcher classifies the data based on more than one attribute, and the number of classes would be twice the number of attributes. It is called "manifold classification". It can be represented as,

   Total Number of Categories = 2n,

   Where, 'n' = Number of attributes

2) **Classification According to Class-Intervals:** Data can also be classified on the basis of numerical characteristics. These characteristics are quantitative in nature, and hence are measured with the help of statistical units. Here, the characteristics are classified on the basis of the defined class-intervals. The examples of these attributes are weight, height, age, etc. These characteristics are called as "statistics of variables".

   For example, a researcher doing a study on 100 respondents chose to classify the respondents into the following four age categories:

Age Group	No. of Respondents
1) Less than 20	15
2) 20-30	11
3) 30-60	45
4) >60	29

4.1.8. Data Entry

The process of converting data (collected from primary or secondary sources) to a more operational and readable form is known as data entry. The backbone of researchers is still a keyboard with the help of which they can generate a data file which acquires less space and can be stored across different media. But, there are more effective methods available to expedite the process of research with the help of optical character and mark recognition and bar codes.

\lternative Data Entry Formats

;alient alternative data entry formats available are as follows:

1) **Keyboarding:** Keyboard presents a more practical method of entering data for statistical packages (such as SAS or SPSS) whereby the complete data file can be browsed or edited. There are various data entry products offered by SPPS like Data Entry Builder and Data Entry Station. Data Entry Builder helps in the making of surveys and forms whereas Data Entry Station makes the entry of staff more centralised, like survey access, online participants or phone interviewers, etc. There are various forms of software offered by SPSS and SAS which can obtain data from data marts, warehouses, spreadsheets or databases in an easy manner.

   i) **Database Development:** A large collection of data which is prepared for recovery via a computer is called a database. Database programs prove to be valuable tools for entering data, especially for huge projects. With the help of these programs the users can connect files and outline the data fields which make the process of recovery, storing and updating easy. An example of database can be orders from a company in the form of information related to the customers, records of order production and shipping, etc., which are stored in separate files. Database enables only authorised people to view those parts which they require.

   Such files are connected to each other so that any change in information is automatically updated in all the files. Acquiring data via e-mails can be another form of database entry which is gaining popularity among e-mail surveys. Respondents can receive surveys on their e-mail address, complete it and return it to the sender's e-mail address. The response is recorded in the database. Another form of recording data can be intranet where the responses of participants connected via network is included in the database of the network server for immediate examination. However, a valid username and password can keep the unwanted users from accessing the database and altering the results.

   ii) **Spreadsheet:** The data that requires arrangement, tabulation and analysis can be compiled in a spreadsheet which is a specialised form of database. Numbered rows and lettered columns are used for data entry on spreadsheet. An entry may be placed on the matrix of thousands of cells. Certain tools of presentation, graphics and database management are also offered by spreadsheets. It makes viewing and entering data very easy.

2) **Optical Recognition:** When any printed text is required to edit and use for some purpose without re-typing it, then Optical Character Recognition (OCR) programs are used to transfer the text into the computer. There are several other uses of OCR. Data collection instruments can be scanned through OCR assisting the researchers. Optical Mark Recognition (OMR) programs are used to process the user-created forms with the help of a spreadsheet-style interface. **For example,** in examinations, for marking their answers, students are required to darken the circles or spaces between the fixed parallel lines on OMR sheets. These responses are read by the OMR program through optical scanners which scan the responses and store it in a file. This method of data entering and processing has several benefits such as cost-effectiveness, ease of charting and reporting data, faster speed, improved accuracy, less data handling time, less errors, etc.

3) **Voice Recognition:** The innovations in data collection methods are on the rise due to the growth of random computer dialling. Voice response and recognition is one of such innovations. These can be used as an alternative to telephonic interviews. The computer on receiving the voice response on any random call gets into a questionnaire mode and records the responses. Such technologies are growing rapidly and soon will be able to convert recorded voices into data files.

4) **Digital:** Another data entry alternative is technology of telephones connected with computers, i.e., telephone keypad response. It is more often employed by restaurants etc., in order to measure the level of customer service. In this technology, the participant presses the desired number in order to answer a particular question. The electronic signal of the tone associated with that number is recorded by the computer. The components of software present in MS Office XP also include the function of speech recognition. People can speak into the microphone and directly enter data into the computer through the mere use of their voice.

5) **Bar Code:** Earlier the bar code was just a technological curiosity. Now, after the implementation of Universal Product Code in 1973, it has developed to become a business necessity. The grocery retail chain, Kroger, tested a production system using bar codes. After this, the bar codes became a significant part of the grocery industry.

Bar codes make it convenient for the interviewers to record data. The data is easily captured in the form of little units as soon as the interviewer moves the scanner over the codes. The little units can be translated later on. Another application of bar code can be seen in the calculation of population, where in 2000, the Census Data Capture Centre made use of bar codes to identify the citizens. Also, researchers who are trying to calculate the readership of a magazine can scan the code of the cover identified by the participant of the research.

There are many applications of bar code such as ID bracelets of patients, point of sale terminals, inventory control, tracking of brand, product and shipments, evaluation of promotional technique, locations of rental cars (tracking their speed and generating invoices), marathon runners, tracking of breeding habits of insects and so on. Bar codes of length as long as 2 feet are used by military for labelling their boats in the harbour. Bar codes can also be seen on parts of trucks, timber in lumberyards and several business-related documents. Codabar is the code used by Federal Express shipping labels. There are several codes having numbers and letters in them that could be used by the researchers.

4.1.9. Tabulation

Tabulation is a method of presenting the data in the form of tables so that the results can be interpreted easily. The purpose of tabulation is to present maximum possible information in minimum possible space. In tabulation, the data are represented in a compact form in such a way, that the quality and utility of information is not lost.

Tabulation is the final stage of data processing which provides the data for further analysis. It serves the purpose of presenting the data to the client in an aesthetic and easily understandable format. Tabulation is a kind of visual representation that aids the researchers in further analysis and interpretation as well as presentation of data in final stage.

4.1.9.1. Characteristics of a Good Table

1) **Suit the Purpose:** A table should be in keeping with the object of statistical enquiry.

2) **Scientifically Prepared:** The table should be prepared in a systematic and logically organised manner, simple and compact so that it is readily comprehensible. It should be free from all sorts of over-lapping and ambiguities.

3) **Clarity:** A table should be easily understandable, complete and self-explanatory.

4) **Manageable Size:** A table should be so designed that it is neither very long and narrow nor very short and broad. If need be, it should be adjusted to the space provided for the purpose.

5) **Columns and Rows should be Numbered:** When there are a number of rows and columns in a table, they must be numbered for reference.

6) **Suitably Approximated:** If the figures are large, they should be suitably approximated or rounded. The method of rounding should be indicated alongwith the units of measurement such as a weight in thousand tonnes rounded to the nearest whole number.

7) **Attractive Get-Up:** A table should have an attractive get-up which is appealing to the eye and the mind so that the reader may grasp it without any strain. The rows and columns are separated by single, double or thick lines depending on the broad classes and sub-classes used. Related percentages are given close to corresponding columns and rows. Whereas columns are invariably separated by lines the rows may or may not be so separated.

8) **Units:** The unit designations should be given at the top of the table below the title such as 'price in rupees' and 'weight in tonnes'. If there are different units for different items then they should be mentioned in respective columns and rows.

9) **Averages and Totals:** The averages and percentages should, as far as possible, be given to the right or at the bottom of the columns containing original figures. Totals and sub-totals of both columns and rows and, if necessary, the cross totals of each such group should be given.

10) **Logical Arrangement of Items:** There should be logical and systematic classification of items in the table. Items may be arranged:
   i) Alphabetically,
   ii) Geographically,
   iii) Chronologically,
   iv) Conventionally, and
   v) In order of magnitude, in ascending or descending order.

11) **Proper Lettering:** It is not advisable to use too many styles of letters in a table. Large capital letters and bold face type may be used for headings, stubs, captions, and small letters may be used for prefatory notes, footnotes and, source notes. Lettering also helps in adjusting the size of the table.

4.1.9.2. Types of Tables

Tables can be categorised as follows:

1) **Based on the Number of Characters Used:** These tables are categorised based on the number of characters used to classify the data, and are of two types:
   i) **Simple Table or One-Way Table:** In a one-way table, the classification is made on the basis of only one character. Since, it is the simplest form of table, hence it is also called "simple table".

   For example, following table shows number of students in a particular course in a university:

Students	Total Students
MBA	200
PGDBM	100
Total	300

   ii) **Complex Tables:** When a table is prepared on the basis of more than one characteristic, it is known as "complex table". In such tables, more than one classification is represented. In higher level tables both the rows and columns are included. Here, the column represents the category of the item and row represents value of the item. Generally complex tables are of following types:
      a) **Two-Way Table:** Two-way tables are made with two characteristics to classify the data. It is also called "double tabulation". Two-way tables are constructed with the help of one-way table. It is much easier to analyse a two-way table compared to one-way table.

      For example, following table shows the number of students in a college as per the year in the different courses:

Table 4.1: No. of Students in a College (As Per the Year in the Different Course)

Name of Courses	No. of Students		Total Students
	1st Year	2nd Year	
MBA	120	80	200
PGDBM	64	36	100
Total	**184**	**116**	**300**

      b) **Three-Way Table:** When a table is constructed with the help of three inter-related characteristics, it is known as "three-way table" or "treble tabulation". By showing three characteristics at a time, a three-way table shows more information regarding a particular phenomenon compared to one-way and two-way tables.

      For example, following table shows the number of students in a college according to North and South region, the course, and the year of the course:

Courses	North Region		South Region		Total Students
	1st Year	2nd Year	1st Year	2nd Year	
MBA	80	60	40	20	200
PGDBM	40	12	24	24	100
Total	120	72	64	44	300

c) **Multiple-Way Table:** A multiple-way table is constructed in the same way as one-way, two-way, and three-way tables are constructed. But the difference here is that there are multiple characteristics which are used to tabulate the data. Usually these types of tables are constructed while collecting census data. These are also known as "manifold tables".

For example, following table categorises four characteristics, which are courses, graduation stream of the students, north and south region, and year:

Courses	Graduation Stream	North Region		South Region		Total Students
		1st Year	2nd Year	1st Year	2nd Year	
MBA	Arts	20	15	20	5	60
	Science	30	25	10	5	70
	Commerce	20	10	5	5	40
	BBA	10	10	5	5	30
PGDBM	Arts	10	2	6	4	22
	Science	10	6	6	8	30
	Commerce	10	0	6	8	24
	BBA	10	4	6	4	24
Grand Total		120	72	64	44	300

As the number of characteristics increase, the complexity of tabulation also increases. It is not advisable to include more than four characteristics as the table becomes very complex and in turn creates confusion. When more than four characteristics are to be used, then more than one table can be constructed by the researcher, to reduce the complexity.

2) **Based on the Purpose of Study:** On the basis of purpose, tables are of following types:

i) **General Purpose Table:** General purpose tables represent large quantity of data at a time. It acts as storage of huge amount of information in a compact form. It is usually a very big table as it tries to accommodate all the information in a single table. It is also called a "Repository table" or "Reference table" as it helps the researchers in taking references for information. Census table and appendices are some of the examples of general purpose tables.

ii) **Special Purpose Table:** These tables are comparatively small as less amount of information is represented which are specifically related to the research objective. These tables are also called "summary table" or "text table". These tables help in comparative data analysis related to a specific research problem.

4.1.9.3. Rules of Tabulation

The rules regarding the construction of table and general rules (or precautions or points to be kept in mind) are as follows:

1) **Rules Regarding the Table Structure**

i) **Table Number:** When a number of tables are constructed, serial number should be given to each table.

ii) **Title:** The title of the table should be clear and precise indicating "what, where, and when" of the data in that order.

iii) **Number of Rows and Columns:** The number of rows and columns depends on the nature of the data. Description of rows, columns, sub-rows sub-columns should be well defined. Columns and rows should be numbered when it is desired to facilitate reference to specific parts of a table.

iv) **Captions and Stubs:** The headings of various columns and rows (often called captions and stubs respectively) should not consist of more lines or words than the bare 'minimum' required.

v) **Ruling and Spacing:** Horizontal and vertical lines should be drawn to separate adjacent rows and columns. Different colours or lines of differed dimensions (i.e., light, heavy, etc.) should be used to differentiate sub-rows and sub-columns from the main rows and main columns.

The appropriate space must be given between the figures.

vi) **Size of Columns:** The size (breadth) of the columns should be according to the information to be written in those columns.

vii) **Arrangement of Items:** The placement of items in the rows or columns should be, if possible, in natural order or according to their importance.

viii) **Units and Derivatives:** The unit of measurement used should be clearly stated such as 'prices in rupees', 'population in crore', etc.

ix) **Explanatory Notes:** To make certain points clear, the explanatory notes (foot notes or head notes) should be incorporated directly in body of the table or under or above the table. If the information gain in the table is not self-explanatory, sufficient information should be given as foot notes.

x) **Source:** The source of information must be mentioned just below the table particularly in case of secondary data. Such notes give:
   a) The name of the person/ institution.
   b) Place and other details and
   c) An idea about their reliability.

xi) **Totals:** The sub-totals for each separate classification and a general total for all combined classes should be given at the bottom and/or right side of the figures whose totals are taken.

2) **General Rules**

i) **Attractive Shape:** The table should be neat and attractive. The size of the table should be neither too big nor too small.

ii) **Simplicity:** A table should be simple and self-explanatory and according to the object of statistical investigation.

iii) **Place of Approximation:** If approximation is done for the figures written in the table, it should be mentioned.

iv) **Free from Irrelevant Data:** A table must be free from all types of irrelevant data.

v) **Use of Circle or Box, etc.:** Certain figures which are to be emphasised should be in distinctive type or in circle, box or between thick lines.

vi) **Miscellaneous Columns:** A table should have miscellaneous column or remark column for the information which cannot be grouped in the classification mode.

vii) **Non-availability of the Data:** If some information is not available due to one or other reason, a line (–) or not available (N.A.) or a cross (×) should be used, alongwith a description of these symbols.

4.2. DATA ANALYSIS

4.2.1. Introduction

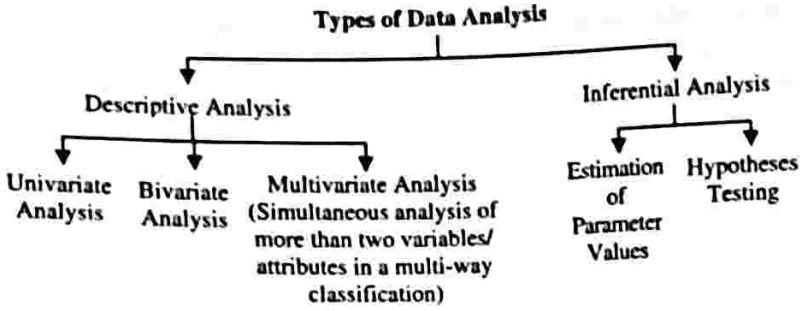
Appropriate analytical tools are used to convert raw data into information that can be used in marketing research. Percentile and ratios are some elementary methods of data analysis. Some statistical methods such as mean, median, mode, percentage, and standard deviation should be used as per requirement. Tests of significance, factor analysis, multiple discriminate analysis, and regression analysis can also be used as advanced statistical tools.

Data analysis can be defined as the process of gathering, modelling and transforming data so as to get useful information, suggestions and conclusions in decision-making.

4.2.2. Objectives of Data Analysis

1) Assessment and improvement of the quality of the data.
2) Compare the target population with the population being studied (sampling population).
3) Forecast the possible areas where faults can occur (such as degree of non-response, amount of denials, the comparison groups or the reduction or decrease in number).
4) Assessment of the measures of frequency (such as mean, median, mode, etc.) and their amount.
5) Assessing, i.e., how much strong relationship exists among the variables.
6) Measurement of the degree of ambiguity.
7) Observe and control the influences of other associated characteristics.
8) Making inferences and taking decisions.
9) To acquire insights regarding the relationships which are being observed or not attended.

4.2.3. Types of Data Analysis


Types of Data Analysis
Descriptive Analysis
Inferential Analysis
Univariate Analysis
Bivariate Analysis
Multivariate Analysis (Simultaneous analysis of more than two variables/ attributes in a multi-way classification)
Estimation of Parameter Values
Hypotheses Testing

1) **Descriptive Analysis:** The descriptive analysis is mainly employed for the purpose of elaborating the data (taken from the population) which is under the sampling observation either graphically or numerically.

   It is possible to carry out the analysis of one, two or more than two variables at the same time. Thus, based on the number of variables used, data analysis can be defined as:

   i) **Univariate Analysis:** It is one of the simplest forms of data analysis. In this method summarization of the data depends on the separate variables of a data set. The use of this technique is mainly related to those cases when the investigator likes to take individual measurement of the sample, or in case when there are many measurements but the researcher studies only one variable at a time.

   ii) **Bi-Variate Analysis:** This analysis is used for the measurement when there is some relationship between two variables. The results are obtained in the form of percentage, scatter plot, histogram table, correlation coefficient, etc. This analysis also identifies that weather the variables which are under the study is dependent or independent.

   iii) **Multivariate Analysis:** Due to the complexity of the research problem in present days, the data analysis has both multiple independent and dependent variables. So, this analysis is used by the researchers when they take two or more variables for the measurement at the same time.

   Note: Based on the nature of the problem, generally every statistical method is classified as univariate or multivariate analysis.

2) **Inferential Analysis/Statistical Inference:** It is used by the investigators when they have acquired the data from the sample through a random procedure (using probability method) and with a high response rate. If the data collection is done through non-probability method with the lower response rate, then this method is not used for the analysis. The two main groups of the problems which are dealt with the statistical deduction are as follows:

   i) **Estimation:** Estimation is a procedure which is employed in the case of the statistics (which is acquired from the sample) for the purpose of estimating the 'unknown parameter' of the population under study.

   ii) **Hypotheses Testing:** Hypothesis testing is the procedure to examine the hypothesis of the main population from where the sample has been drawn.

4.2.4. Qualitative and Quantitative Data Analyses

The two types of data on which the analysis can be done are quantitative and qualitative and are therefore called:

1) Qualitative data analysis and
2) Quantitative data analysis.

4.2.4.1. Qualitative Data Analysis

QDA or Qualitative Data Analysis starts during the process of data collection. It does not wait for the process of data collection to end. QDA is a repetitive and automatic process where the analysis of raw data is in text form instead of numbers.

QDA process should be done in public rather than in private so that the demonstration of arriving at conclusions can be seen by others which would encourage discussion, if required. In order to confirm the findings the study can be repeated. However, such replication of studies might not be viable for market researches. But if the achieved results can be stretched to different people, then those results might be given some importance.

Characteristics of QDA

The characteristics of QDA are as follows:

1) **Iterative and Progressive:** The QDA process is a repetitive cycle, therefore, it is progressive and iterative. **For example**, inspection on data helps in observing other things in it. The person then begins to think about and gather those new things. Therefore, the process of QDA can be called an unending cycle.

2) **Recursive:** The QDA process is recursive since one step of the process can regress the researcher to the earlier step. **For example**, during data collection, the researcher may observe new things which would require further collection.

3) **Holographic:** The QDA process can be called holographic since the entire process can be contained in just one step. **For example**, the researchers might be thinking about gathering new things in their minds as soon as they see it.

Steps of QDA

The steps involved in QDA are as follows:

1) **Detecting Things (and Coding Them):** In a general sense, detecting simply means observing, taking field notes, collecting documents, tape recording interviews and so on which enables to keep a record of the things noticed. When a record is maintained, then other exciting things related to the record can be detected by going through it. These detected things are then coded, may be in simple alphabets like A, B or C. However, a more detailed coding system may be developed.

   The process of **coding** is simple which is known to all. **For example**, highlighting, underlining and making margin notes while reading a book is a form of coding.

2) **Collecting and Sorting Instances of Things:** After detecting and coding of things there comes the step of collection and sorting them. This step can be compared to solving a jigsaw puzzle which usually requires categorising the puzzle pieces. **For example**, a very standard approach to solve a puzzle with a house, an animal and a tree would be to first sort out the pieces of the house, tree and the animal into different groups.

3) **Thinking about Things:** This step usually requires studying about things that are gathered. The objectives here are as follows:
   i) Trying to make sense about the things gathered.
   ii) Recognising relationships and patterns among different collections and also within the collection itself.
   iii) Making general discoveries regarding the researched phenomenon.

4.2.4.2. Quantitative Data Analysis

The data which is in the form of numbers and is an outcome of some form of measurement is known as quantitative data. A value is selected from the scale of values in measurement and it relates to the response given by an individual to a particular question, or observing any object or situation. The value scales may be classified into metric and non-metric which can be further classified into discrete and continuous, and ordinal and nominal scales.

There is a requirement of data analysis when a large number of cases are to be measured or in simple terms, when a variable represents a number of values. The name 'unit of analysis' is assigned to a particular group of cases for which set of values are used for analysing it. Treating them as a whole entity the features of this group of cases are displayed, interpreted and summarised. The resulting conclusion is not a feature of any single case but of the unit of analysis. **For example**, if the average weight of 10 people (considered as a unit of analysis) is 52.3 kg, then this number is a characteristic of those 10 people and not of a single person.

A particular research study may have a number of units of analysis. This might be due to the presence of certain subsets that require analysis at a single point of time or the missing cases in tables which alter the basis of calculation in the tables.

4.2.4.3. Qualitative *versus* Quantitative Data Analyses

Basis of Difference	Qualitative Data Analysis	Quantitative Data Analysis
1) **Interpretation**	Logic and interpretation is the basis of this analysis. Here, arguments and texts are used by researchers to present their analyses.	Statistics is the basis of this analysis. Here, graphs and charts are used by researchers to present their analysis.
2) **Procedures and Rules**	There are guidelines but no rules to support qualitative analysis.	There are accepted rules and procedures in quantitative analysis.
3) **Occurrence**	Qualitative analysis and collection of data occur together.	Quantitative analysis takes place after the collection of data.
4) **Methodology**	The methodology of qualitative analysis varies according to different situations.	The methodology of quantitative analysis is pre-decided during the selection of research design.
5) **Reliability**	It is valid but lacks reliability. They lack consistency in making comparisons between variables under different situations.	It is reliable and consistent in comparing variables under different situations.
6) **Questions**	The questions are open ended in nature which brings out different aspects of the information thereby stressing on diversity.	The questions are specific and standardised that yield predetermined and fixed responses.
7) **Information**	The information provided by qualitative data analysis is specific to the context of the applicability of the program.	The information provided by quantitative data analysis is broad in the context of the applicability of the program.
8) **Suitability**	Effective when limited resources and time is available.	Requires more resources and time as it involves thorough interviewing.

4.2.5. Phases of Data Analysis

Basically data analysis is divided in two phases:

1) **Preliminary Data Analysis:** Preliminary data analysis is applied before the hypothesis testing for obtaining the knowledge about the properties of the collected data.

   This analysis clarifies that how well the coding, inputting, scaling are done. It also clarifies the data validity or systematic bias. The outcome of this analysis influences result and conclusion.

2) **Hypothesis Testing:** It is required to check the assumptions before testing hypothesis to improve the interpretation of the results of the tests. Hypothesis testing finds the validity of the assumption with a view to choose between two opposite hypothesis about the population parameter.

4.3. BI-VARIATE ANALYSIS

4.3.1. Introduction

Bi-variate analysis is concerned with the relationships between pairs of variables (X, Y) in a data set. The following data analysis situations can be visualized, depending on the measurement levels of variables and whether there is any distinction between dependent and independent variables. Bi-variate analysis is the simultaneous analysis of two variables. It is usually undertaken to see if one variable, such as gender, is related to another variable, perhaps attitudes toward male/female equality.

For example, suppose we wanted to find out if gender was related to attitudes toward equality between men and women and had measured each variable at the nominal level. The variables are:

1) **Gender:** Measured as male or female; and
2) **Attitude:** Measured simply as a "in favour of" or as "opposed to" gender equality.

To test the relationship between gender and attitude, hypothesis can be developed based on the following theoretical base:

1) Formation of attitudes is based on socialization, which begins in infancy and extends over many years;
2) In all societies, males and females are socialized according to different norms;
3) The female sub-culture generally favours imparting positive attitudes toward gender equality, whereas the male sub-culture stresses maintenance of male prerogatives.

This theory of self-interest suggests that females are socialized in ways to acquire more favourable views toward gender equality. We therefore designate gender as the independent variable and attitudes toward gender equality as the dependent variable for this analysis. On this basis, we can establish the following hypothesis:

Adult females have more favourable views toward gender equality than adult males.

Bi-variate analysis is concerned with the relationship between values of two variables, a pair of values being known for each of a number of individuals or entities. The two variables may be conventionally labelled X and Y and the values for each individual $x_1, y_1; x_2, y_2; \ldots x_n, y_n$. The term data point will be used for the pair of values of the variables of any one individual. Three cases may be distinguished:

1) Both variables are numerical;
2) Both variables are categorical; or
3) One variable is numerical and the other is categorical. Each of these cases will be reviewed.

Bivariate Statistical Techniques

1) Correlation Analysis
2) Linear Regression Analysis
3) Association of Attributes
4) Two – way ANOVA

4.3.2. Cross Tabulation

Statistics is commonly used for assessing the statistical significance and strength of association of cross-tabulated variables. The statistical significance of the observed association is commonly measured by the chi-square statistic. The strength of association, or degree of association, is important from a practical or substantive perspective. Generally, the strength of association is of interest only if the association is statistically significant. The strength of the association can be measured by the phi correlation coefficient, the contingency coefficient, Cramer's V, and the lambda coefficient.

"A cross-tabulation is a technique that describes two or more variables simultaneously and results in tables that reflect the joint distribution of two or more variables that have a limited number of categories or distinct values".

A cross tabulation displays the joint distribution of two or more variables. They are usually presented as a contingency table in a matrix format. A contingency table contains a cell for every combination of categories of the two variables. Whereas a frequency distribution provides the distribution of one variable, a contingency table describes the distribution of two or more variables simultaneously. Each cell shows the number of respondents that gave a specific combination of responses, that is, each cell contains single cross tabulation. Cross-tabulation is one of the most useful analytical tools and is a main-stay of the market research industry.

Cross-tabulation analysis, also known as contingency table analysis, is most often used to analyse categorical (nominal measurement scale) data. A cross-tabulation is a two (or more) dimensional table that records the number (frequency) of respondents that have the specific characteristics described in the cells of the table. Cross-tabulation tables provide a wealth of information about the relationship between the variables.

Example:

Sample	Gender	Handedness
1	Female	Right-handed
2	Male	Left-handed
3	Female	Right-handed
4	Male	Right-handed
5	Male	Left-handed
6	Male	Right-handed
7	Female	Right-handed
8	Female	Left-handed
9	Male	Right-handed
10	Female	Right-handed

Cross-tabulation leads to the following contingency table:

	Left handed	Right-handed	Total
Male	2	3	5
Female	1	4	5
Total	3	7	10

4.3.3. Use of Percentages

When data from a survey are cross-tabulated, percentages help the researcher understand the nature of the relationship by allowing relative comparison. The total number of respondents or observations may be utilized as a 'base' for computing the percentage in each cell.

When the objective of the research is to identify a relationship between the answers to two questions (or two variables), it is common to choose one of the questions as the base for determining percentages.

Fortunately, there is a conventional rule for determining the direction of percentages if the researcher has identified which variable is the independent variable and which is the dependent variable.

The percentages should be computed in the direction of the independent variable. That is, the marginal total of the independent variable should be used as the base for computing the percentages.

Although survey research does not identify cause-and-effect relationships, one might argue that it would be logical to assume that a variable such as one's gender might predict shopping behavior, in which case independent and dependent variables may be established for the purpose of presenting the most useful information.

4.3.4. Correlation Analysis

Study of the linear relationship between two variables is known as correlation. If there are two variables and changes in the value of one variable will affect the value of the other variable then both the variables are correlated.

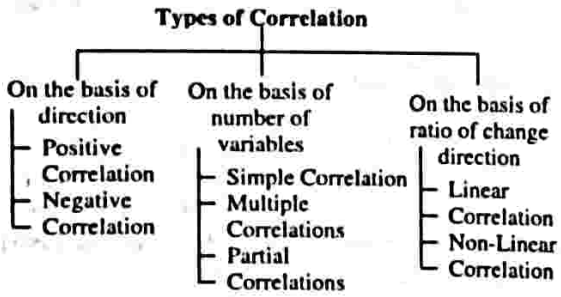
Correlation is a statistical tool used to measure the relationship between two sets of variables and express each in a precise manner.

According to Croxton and Cowden, "The appropriate statistical tool for discovering and measuring the relationship of quantitative nature and expressing it in brief formula is known as correlation".

According to A. M. Tuttle, "An analysis of the covariance of two or more variables is usually called correlation".

4.3.4.1. Types of Correlation

Categorisation of correlation is done on various bases such as on the direction of change of the variable, constancy of the ratio of change between the variable, etc.



1) **Positive Correlation and Negative Correlation:** Depending on the direction of change of the variables, correlation may be positive or negative.
   i) **Positive Correlation:** Correlation is positive when two variables vary in the same direction. **For example,** consider the correlation between sales and expenses of a firm **(table below).**

Firms	1	2	3	4	5	6
Sales (in ₹)	50	60	70	80	90	100
Expenses (in ₹)	11	15	19	23	27	31

ii) **Negative Correlation:** Two variables are said to be negatively correlated when both the variables vary in the opposite direction. When one variable increases then other variable decreases and *vice versa* is also a negative correlation. **For example,** consider the correlation between production and price of crop.

Production (in kg)	100	200	300	400	500	600	700	800
Price (₹ Per kg)	10	9	8	7	6	5	4	3

2) **Linear Correlation & Non-linear (Curvilinear) Correlation:** On the basis of constancy of the ratio of change between the variable, correlation may be linear or non-linear

i) **Linear Correlation:** In a linear correlation, change in the values of one variable has a fixed ratio to the variation in the values of other variable. When these variables are plotted on a graph, then plotted points would fall on a straight line. **For example,** consider the following relationship shown in the table.

Mustard (kg)	10	20	30	40	50	60	70	80
Oil (Kg)	3	6	9	12	15	18	21	24

ii) **Non-Linear (Curvilinear) Correlation:** In a non-linear correlation, change in values of one variable does not have a fixed ratio to the variation in the value of other variable. When these variables are plotted on a graph, then plotted points would fall on a curve. **For example,** consider the following relationship shown in the table.

Use of Fertilizer (in kg.)	1	2	3	4	5
Production of Rice (in kg.)	4	6	9	17	28

3) **Simple, Partial & Multiple Correlation:** Depending on the number of variables studied, it can be categorised into three types:

i) **Simple Correlation:** When we measure the linear relationship between two variables then this interpretation is known as simple correlation, **e.g.,** relationship between sales and expenses, income and consumption etc.

ii) **Partial Correlation:** If we have various related variables and try to find out the relationship between two variables then it is known as partial correlation. **For example,** consider the two variables height and weight, which are partially correlated because of the effect of third variable 'age' on height and weight. In this condition, if we neglect the effect of age, and study the relationship between height and weight, then this correlation is known as partial correlation.

iii) **Multiple Correlation:** It is defined as the measurement of the effect of multiple variables on one variable. **For example,** if we try out to find the relationship of rainfall and temperature on the yield of wheat, then this is known as multiple correlation.

4) **Degree of Correlation:** On the basis of coefficient of correlation, the degree of correlation is determined as follows:

i) **Perfect Correlation:** If two variables change in the same direction and in the same proportion, the correlation between the two variables is called perfect positive correlation. According to Karl Pearson the coefficient of correlation in this case is +1. If two variables change in the opposite direction and in the same proportion, the correlation between the two variables is called perfect negative correlation. In this case the coefficient of correlation is – 1.

ii) **Absence of Correlation:** If two series of two variables show no relation between them or change in one variable does not lead to a change in the other variable, then it means that there is no relationship between variables. In this case, the coefficient of correlation is zero.

iii) **Limited Degree of Correlation:** If two variables are not perfectly correlated or there is an absence of perfect correlation, then it is referred as Limited correlation. It may be positive, negative or zero but lies with the limits ± 1. High degree, moderate degree and low degree are the three categories of this kind of correlation. If the value of coefficient of correlation (represented by 'r') is lies between ±0.75 to ±1,

it is known as **High degree** of correlation and when the value of r lies between ±0.25 to ±0.75 then it is known as **Moderate degree** of correlation. When the correlation lies between 0 and ± 0.25, **low degree** of correlation is said to exist (**table 4.2**).

Table 4.2: Degree of Correlation

Degree	Positive Correlation Co-efficient	Negative Correlation Co-efficient
1) Perfect	+1	–1
2) Limited		
i) High	Between + 0.75 to + 1	Between – 0.75 to –1
ii) Moderate	Between + 0.25 to + 0.75	Between – 0.25 to – 0.25
iii) Low	Between 0 to 0.25	Between 0 to – 0.25
3) Absence	Zero	Zero

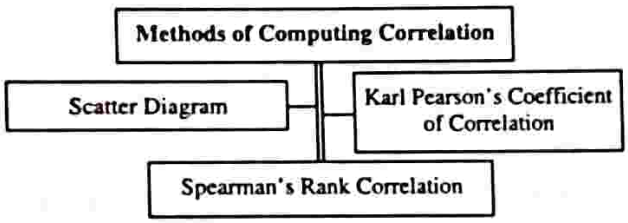
4.3.4.2. Correlation Coefficient

The extent of measurement as to how much one number can expect to be influenced by changes in another number is known as correlation coefficient. **For example,** measuring the value that how much the share price of a company is expected to get influenced, when there are fluctuations in the index. If the two numbers are perfectly correlated then it means that value of correlation coefficient is +1. If one grows the other also grows, and the change in one is a multiple of the change in the other. If the numbers are perfectly inversely correlated then it means that value of correlation coefficient is –1. If one grows the other falls. The growth in one variable is a negative multiple of the growth in the other variable. If the two variables are not related then the correlation coefficient is zero.

When numbers are related and the coefficient is either 1 or -1 and other influences and relationship between two numbers is not fixed then this is known as non-zero correlation coefficient. If one number is known, the other number can be calculated, but with uncertainty. Uncertainty increases when correlation coefficient is more towards to zero. But this relationship is not useful, if the correlation coefficient is very low.

4.3.4.3. Methods of Computing Correlation

The various method of computing linear correlation can be shown diagrammatically as follows:

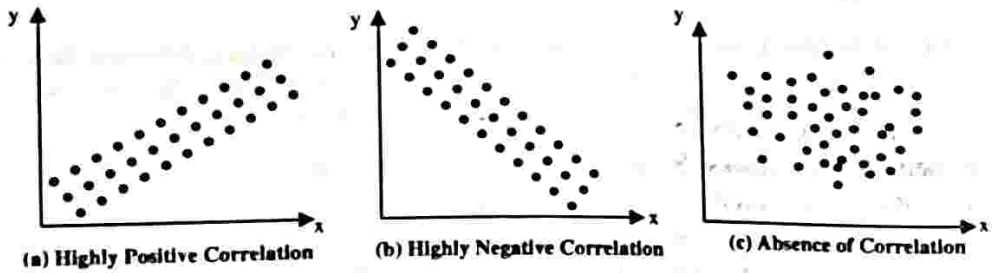


4.3.4.4. Scatter Diagram

Graphical presentation of the relationship between two variables calculated on the same set of individual is known as **scatter diagram.**

Note: Scatter diagram is a dot chart specially used to show the correlation.

For example, if we plot a dot chart for some predefined value of two variables and get some trends (either upwards or downwards) in the chart, then the trend shows a correlation between both the variables. The idea will be clear from the **figure 4.2:**



(a) Highly Positive Correlation (b) Highly Negative Correlation (c) Absence of Correlation

Figure 4.2

1) In **figure 4.2 (a)**, the values of the two variables move in the upward direction, hence the correlation is positive.
2) In **figure 4.2 (b)**, we find negative correlation as the values move in reverse direction.
3) In **figure 4.2 (c)**, we don't get any trend lying and hence it shows the absence of correlation and $r = 0$.
4) In **figure 4.3**, the value of the two variables moves in the same direction and when $r = +1$ then its shows perfect positive correlation and when $r = -1$ then its shows perfect negative correlation.

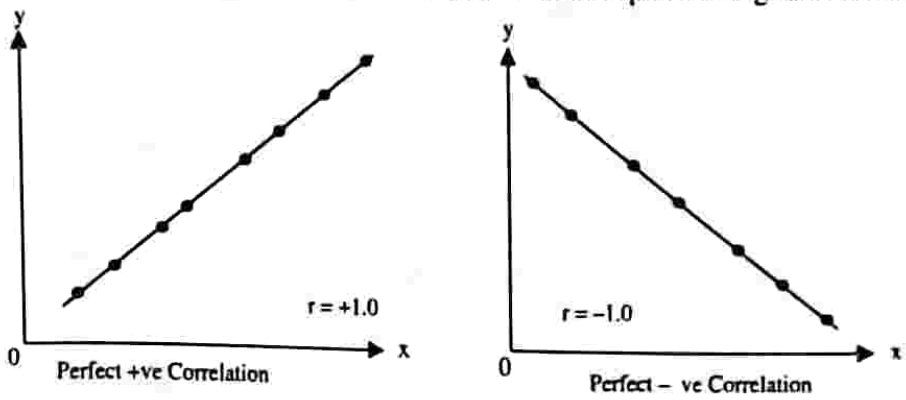


Figure 4.3

4.3.4.5. Karl Pearson's Coefficient of Correlation

To calculate the magnitude of linear relationship between two variables Karl Pearson (biometrician and statistician) gave a quantitative technique. This technique is known as **Pearsonian Coefficient of Correlation (r)** and is extensively used in practice.

Properties of Karl Pearson's Coefficient of Correlation

1) Ideal measure of correlation and is independent of the units of the variables.
2) Free from change of origin and scale.
3) Based on all observations.
4) Lies between −1 and +1 and when:
   i) $r = -1$, shows a perfect negative correlation between variables.
   ii) $r = 0$, then there is no correlation between variables.
   iii) $r = +1$, shows a perfect positive correlation between variables.

4.3.4.6. Spearman's Rank Correlation

Spearman's Rank Correlation coefficient named after **Charles Edward Spearman** and denoted by **R**, is a technique to find the correlation between the ranks of two series. This technique is used when value of variable cannot be calculated quantitatively. To apply the Spearman's rank correlation technique we need to first arrange the value of variable in serial order. We apply this method when we deal with qualitative characteristics. **For example,** when we test the IQ of a person with the number of hours spent in front of TV per week, etc. Spearman's rank correlation coefficient (R) is defined as,

$$R = 1 - \frac{6\sum D^2}{N(N^2 - 1)}$$

Where,

R = Rank Coefficient of Correlation,
D = Difference between Two Ranks ($R_1 - R_2$),
N = Number of Pair of Observations.

Rank Correlation Coefficient (R) always exists between −1 and +1and also used when the measurements are given for both the series.

4.3.5. Regression Analysis

Regression analysis is a statistical tool used to calculate a continuous dependent variable from various independent variables and is commonly used for prediction and forecasting. **For example,** if agriculturist knows that the yield of rice and rainfall are closely related then he will want to know the amount of rain required to achieve a certain production. In this situation, he will use the regression analysis. This technique is used for modelling and analysis of mathematical data using the value of a **dependent variable** and one or more **independent variables.** Dependent variable, also known as **response variable,** is the single variable predicted by the regression model. Independent variable, also known as **predictor variable,** is used to predict the values of dependent variable.

4.3.5.1. Meaning of Regression

Regression analysis is the process to calculate the unknown value of one variable from the known values of the other variable.

According to Blair, "Regression is the measure of the average relationship between two or more variable in terms of the original units of the data".

According to Taro Yamane, "One of the most frequently used techniques in economics and business research, to find a relation between two or more variables that are related causally, is regression analysis".

Regression analysis makes an equation to describe the statistical relationship between one or more predictor variables and the response variable.

It helps to know, how to determine the nature and strength of a relatonship between independent and dependent variables. Regression may be classified as follows:

i) Simple Regression
ii) Multiple Regreesion
iii) Linear Regreesion
iv) Non-linear Regression

4.3.5.2. Regression Coefficient

If 'b' is the slope of regression line of 'Y on X', then b_{YX} is known as coefficient of regression of 'Y on X'. So,

$$b_{YX} = \text{Regression Coefficient of Y on X} = r\frac{\sigma_Y}{\sigma_X}$$

Similarly, for the regression line of 'X on Y',

$$b_{XY} = \text{Regression Coefficient of X on Y} = r\frac{\sigma_X}{\sigma_Y}$$

4.3.5.3. Two Lines of Regression

The lines of the best fit between two variables and stating the common average relationship are known as regression lines. There are two regression lines for two variables.

When we take two variables X as dependent variable and Y as independent variable, then the straight line is called as the **regression line of X and Y** and *vice versa* is also true.

The regression line of **Y on X** gives the finest possible values of Y for the given values of X. So this line is the sum of squares of deviations of the 'calculated values of Y' and 'observed values of Y is minimum'; i.e.,

$$\Sigma(Y_c - Y_0)^2 = \text{minimum}$$

Where,

Y_c = Calculated value of Y
Y_0 = Observed value of Y

Now, for the regression line of **X on Y**:

$\sum(X_c - X_0)^2$ = minimum.

Where,

X_c = Calculated value of X

X_0 = Observed value of X

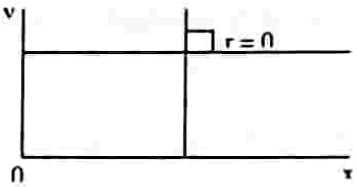


Figure 4.4: Two lines of Regression

This is why, to understand the concept of regression line, two regression lines are required. If there is only one regression line existing between two variables then it means $r = \pm 1$.

Now If the value of r is 0, then both the variance are independent and lines will cut each other at a right angle (i.e., lines will be parallel (||) to x-axis and y-axis) (**figure 4.4**).

4.3.5.4. Relationship between Correlation and Regression Coefficient

Regression equation is used to show the regression line and there are two regression equations because there are two regression lines.

So if there are two variables, say X and Y, then the two regression equations are written as:

1) **Regression Equation of X on Y:** The regression equation of 'X on Y' is written as follows:

$$X = a + bY$$

To calculate the values of a and b, following normal equations are solved simultaneously:

$$\sum X = Na + b\sum Y$$
$$\sum XY = a\sum Y + b\sum Y^2$$

2) **Regression Equation of Y on X:** The regression equation of 'Y on X' is written as follows:

$$Y = a + bX$$

To get the value of a and b, following normal equations are to be solved simultaneously:

$$\sum Y = Na + b\sum X$$
$$\sum XY = a\sum X + b\sum X^2$$

In the normal equation $\sum X$, $\sum XY$, $\sum X^2$ and $\sum Y^2$ gives the summations and can be determined from the observed pairs of values of two variables 'X and Y'. N is the number of observed pairs of values.

4.3.5.5. Application of Regression Analysis

Following are the basic uses of regression analysis:

1) Used to know the relationship between different (one or more) variables.
2) Used to find out the value of dependent variable from the value of independent variables.
3) Used to find out the coofficients of correlation (r) and coofficients of determination.
4) In corporate sector it is useful to check the quality.
5) Also very useful to determine the statistical curve (demand, supply, etc.).

4.3.5.6. Difference between Correlation and Regression Analysis

Base	Correlation	Regression
Meaning	Study of the linear relationship between two variables is known as correlation.	It is a statistical tool used to calculate a continuous dependent variable from various independent variables.
Variables	Random variables are used.	One variable is random variable and other is fixed variable. It may be possible that sometime both the variables are random.
Relationship	It does not indicate the cause and effect relationship between variables and gives the degree of relationship.	It shows the cause and effect relationship between variables and creates a functional relationship.
Uses	Used to test the relationship between two variables.	Used for prediction and forecasting.
Value/ Range	It is a relative measure and its coefficient is lies between −1 to +1.	It is an absolute value. It is possible that the coefficient is greater than 1.
Mathematical Treatment	Not much valuable for further mathematical treatment.	Widely used for further mathematical treatment.
Dependency of Variables	Dependency of variables on each other is not important.	Its shows the functional relationship between the two variables.

4.3.6. Analysis of Variance (ANOVA)

The Analysis of Variance is similar to the regression analysis. It is abbreviated as ANOVA, developed by **R.A. Fisher**. ANOVA is widely used by the researchers to investigate the underlying relationship between a dependent variable and various independent variables.

It is widely used in the areas of business, industries, economics, psychology, sociology, biology etc. The researchers prefer the ANOVA when there are multiple cases of sample. It is a statistical tool which is used to analyse the variations among the data and calculate the inequality among the population means.

Using z-test or t-test, researcher does the study to find the significance of the difference between the means of the two samples but problem occurs when he tries to measure the significance of the difference of more than two sample means at the same time. The statistical tool ANOVA, removed this problem. By using ANOVA, researcher can conclude, that the samples collected are from the population which have the same mean.

For example, it is useful when the researcher wants to examine the side effects of a medicine on different age groups, the mileages of various motor bikes, eating habits of various cultures, etc. In these situations the researchers do not want to examine all the combinations of the two or more than two populations simultaneously, because it will require lot of research tests to come to any conclusion.

Moreover, it requires a researcher to spend a lot of resources, money and time. In these kinds of situations, the researchers prefer to use of ANOVA as it helps them to examine the differences of the sample means of various populations at the same time.

ANOVA also checks the level of homogeneity among the various groups of samples from different populations. The use of ANOVA by researcher helps them to divide the total variation of the various samples in two groups.

1) The first variation is that which occurs due to chance and
2) The second variation is that which occurs due to any specific cause.

ANOVA helps the researcher, to split the variance for investigative purpose. With the use of ANOVA the researchers can examine 'n' number of factors influencing the dependent variables.

In simpler words, Analysis of Variance (ANOVA) is a statistical technique which is used for exploring the variation of a dependent variable with respect to independent variables.

In the ANOVA technique when single factor is taken and researcher analyses the difference amongst its various categories which have numerous possible values, then this ANOVA technique is known as **one-way ANOVA**. When analysis is done on two factors at the same time, then this ANOVA is known as **two-way ANOVA**.

4.3.6.1. Characteristics of Analysis of Variance (ANOVA)

1) ANOVA research tool is helpful in the study of analysis of variance.
2) One of the most important characteristics of ANOVA is that it splits the variance into chance variance and cause variance.
3) ANOVA is used in the examination of the various comparative experiments.
4) ANOVA results are free from any type of constant bias and scaling errors.
5) It describes the true and complete characteristics of given populations.
6) It examines the variance of more than two groups of samples.

4.3.6.2. Assumptions of Analysis of Variance (ANOVA)

Analysis of variance is done on the basis of some assumptions. These assumptions are given below:

1) Normally distributed universe used to take the sample for the study.
2) Samples are selected randomly and they are also homogeneous and independent of each other.
3) It is assumed that there is no significant difference amongst the variances of the different universes from which the samples have been drawn.

4) Starts with the null hypothesis i.e., $V_1 = V_2 = V_3 = ...V_n$ (where, V_1, V_2, V_3 ....V_n are variance)
5) It is assumed that the critical values of the variance ratio, (F) as estimated by Snedecar for different degrees of freedom at different level of significance, viz.; 5%, or 1%, etc., hold good in testing the significance of the calculated values of F that represents the variance ratio of the samples.

4.3.6.3. Applications of ANOVA

1) With the help of the ANOVA an organic scientist or researcher can elaborate whether different varieties of fertilizers, seeds or soils differs significantly or not. This helps the researchers to draft the policy accordingly to the outcomes.
2) If the medical researchers or scientists are interested to study the impact of the medicine on different age groups of the human beings, then ANOVA is very useful.
3) The top management of an organization may examine the performance of their sales managers working on different population. Using ANOVA, management can come to a decision whether the performance or the efficiency of the sales managers differs significantly or not.
4) The statistical tool ANOVA can help the researcher to study whether the purchase intentions of group of people differs significantly or not.

4.3.6.4. ANOVA Techniques

Following are the two ANOVA techniques:
1) For One-way classification and
2) For Two-way classification.

4.3.6.5. Analysis of Variance for One-way Classification

In the concept of the one way ANOVA, there is an analysis of variance of a continuous dependent variable with a single classification variable (Independent Variable). One-way analysis of variance (ANOVA) always tests equality of the population means when there is classification only by one variable. After calculations we check whether there exists any difference within the factor or not.

Process for Calculation of One Way ANOVA

1) Calculate the means of all sample individually, that find:

$$\overline{X}_1, \overline{X}_2, \overline{X}_3, ..., \overline{X}_k$$

Here, k = Samples Observation

2) Calculate the mean of the sample:

$$\overline{\overline{X}} = \frac{\overline{X}_1 + \overline{X}_2 + \overline{X}_{3+}, ..., + \overline{X}_k}{\text{No. of Samples (k)}}$$

3) Then calculate the deviation of the 'sample means' from the 'means of the sample means'. Then each deviation is squared and multiplied by the total number of the items in corresponding sample. Each item is then added up and the output so obtained is called as **Sum of Squares (SS).**

$$SSB = SS\ between = n_1\left(\overline{X}_1 - \overline{\overline{X}}\right)^2 + n_2\left(\overline{X}_2 - \overline{\overline{X}}\right)^2 + ... + n_k\left(\overline{X}_k - \overline{\overline{X}}\right)^2$$

4) Then we need to divide the 'output is obtained from third step by 'degrees of the freedom'. Then, we get the mean square between samples (MS). It is calculated as follows:

$$MSB = MS\ between = \frac{SSB}{(k-1)}$$

Here the MSB is the mean square between the samples, and (k – 1) denotes degree of freedom (d.f.).

5) The researcher gets the value of the deviations for all of the sample items from their means. Then calculate the square of all the deviations and sum it up. The value so obtained after addition, is called as **sum of the squares** of the variance within sample, abbreviated as (SS within). It can be written as:

$$SSW = SS\ within = \sum\left(X_{1i} - \overline{X}_1\right)^2 + \sum\left(X_{2i} - \overline{X}_2\right)^2 + ... + \sum\left(X_{ki} - \overline{X}_k\right)^2$$

6) Then divide the 'output of fifth step' by 'degree of the freedom' within the samples, in order to get the 'mean square' also abbreviated as MS (mean square or the mean square within sample). It is written as:

$$MSW = MS \text{ within} = \frac{SSW}{(n-k)}$$

Where, $(n-k)$ = represents degrees of freedom within samples,
n = total number of items in all the samples, i.e., $n_1 + n_2 + \ldots + n_k$
k = number of samples.

7) To cross check, the researcher can calculate the sum of the squares of the deviation for the total variance by adding up the squares of all the deviations. This can be done when the deviations of the each item from each individual sample is determined using 'mean of sample means'. This is represented as:

SST = SS for total variance

$$= \sum\left(X_{ij} - \overline{\overline{X}}\right)^2;\ i = 1,2,3,\ldots;\ j = 1,2,3,\ldots..$$

This value of SST is equal to the total of the results of the step three and five. In each case the degree of the freedom is calculated by subtracting 1 from the total number of items in each sample i.e. (n–1). The degree of the freedom in the case of within and between the samples should add to degree of the freedom for the complete variance, this can be represented as: -

$$(n-1) = (k-1) + (n-k)$$

This fact describes the additive property of the ANOVA.

8) Finally, the F-ratio can be represented as:

$$\text{F-ratio} = \frac{MSB}{MSW}$$

The researcher uses this ratio to know if the differences among various samples mean is just because of the sampling fluctuation or it has some significance and cannot be ignored. The researchers consult the table and put the F value for given 'degrees of the freedom' at different significance levels. If the calculated value of F is less than table value of F, then the differences are insignificant and can be considered that it is occurring just by chance and the researcher accepts the Null Hypothesis. If the calculated value of F is more than or equal to the table value of F then the results are significant and the researcher accepts the alternate hypothesis. If calculated F is greater than the table value of F, then the researcher becomes sure for about his conclusions and outcomes.

Example 1: Four machines A, B, C and D are used to produce a certain kind of cotton fabrics. Samples of size 4 with each unit as 100 square metres are selected from the outputs of the machines at random, and the number of flaws in each 100 square metres are counted, with the following result:

A	B	C	D
11	7	12	16
9	9	11	20
14	10	18	23
16	4	9	21

Do you think that there is a significant difference in the performance of the four machines?

Solution: Let us take the null hypothesis that the machines do not differ significantly in performance, i.e., $H_0: \mu_1 = \mu_2 = \mu_3 = \mu_4$

X_1	X_1^2	X_2	X_2^2	X_3	X_3^2	X_4	X_4^2
11	121	7	49	12	144	16	256
9	81	9	81	11	121	20	400
14	196	10	100	18	324	23	529
16	256	4	16	9	81	21	441
$\Sigma X_1 = 50$	$\Sigma X_1^2 = 654$	$\Sigma X_2 = 28$	$\Sigma X_2^2 = 246$	$\Sigma X_3 = 50$	$\Sigma X_3^2 = 670$	$\Sigma X_4 = 80$	$\Sigma X_4^2 = 1626$

$$T = \Sigma X_1 + \Sigma X_2 + \Sigma X_3 + \Sigma X_4 = 50 + 28 + 50 + 80 = 208$$

$$\text{Correction Factor} = \frac{T^2}{N} = \frac{(208)^2}{16} = \frac{44521}{16} = 2704$$

$$SST = \Sigma X_1^2 + \Sigma X_2^2 + \Sigma X_3^2 + \Sigma X_4^2 - \frac{T^2}{N} = 654 + 246 + 670 + 1626 - 2704 = 3196 - 2704 = 492$$

$$SSB = \frac{(\Sigma X_1)^2}{n_1} + \frac{(\Sigma X_2)^2}{n_2} + \frac{(\Sigma X_3)^2}{n_3} + \frac{(\Sigma X_4)^2}{n_4} - \frac{T^2}{N} = \frac{(50)^2}{4} + \frac{(28)^2}{4} + \frac{(50)^2}{4} + \frac{(80)^2}{4} - 2704$$

$$= 625 + 196 + 625 + 1600 - 2704 = 342$$

$$SSW = SST - SSB = 492 - 342 = 150$$

ANOVA Table			
Source of Variation	**Sum of Squares**	**Degrees of Freedom**	**Mean Square**
Between samples	342	3	114
Within samples	150	12	12.5
Total	**492**	**15**	

$$F_{(3,12)} = \frac{114}{12.5} = 9.12$$

The table value for $F_{(3, 12)}$ at 1% level of significance is 5.95. The calculated value of F is greater than the table value. Hence, we reject the null hypothesis and conclude that there is a significant difference in the performance of the four machines.

4.3.6.6. Analysis of Variance for Two-way Classification

The two way Analysis of Variance (ANOVA) technique is widely used by the researcher when data is categorized in to two factors. The two way ANOVA can be better explained by the following examples:

1) A business manager may be interested in analysing the sales data of their sales manager on the basis of the efforts done by them or the area in which they are working.
2) An agricultural researcher or scientist may analyse the rice yield on the basis of the type of seed or fertilizer which is used by the farmers.
3) In a manufacturing unit, the project manager may analyse the output of a machine on the basis of the experience of the worker and the quality of the raw material.

In all the cases the researcher takes the observation at regular interval and makes a note of it. Sometimes, the researcher needs to take some repeated values also.

The ANOVA technique is little different in case of **repeated measurements** where we also compute the interaction variation. Two types of ANOVA techniques are:

1) **ANOVA Technique in the Context of Two-way Design when Repeated Values are not there:** In the case when repeated values are missing, researcher cannot compute sum of the squares directly within the sample. So, the residual or the error variation is calculated by subtracting the sum of variance between varieties of a treatment and variance between varieties of other treatment from the total sum of squares for total variance.

Steps

i) The researcher needs to use a coding device, to make the work simpler.

ii) After this, researcher has to take total of all the individual values (or the coded values) of the entire sample, and name it as T.

iii) Then apply correction factor stated below:

$$\text{Correction factor} = \frac{(T)^2}{n}$$

iv) Calculate the square value of all the items (or square of the coded values) taken individually and then sum it up. Then subtract the correction factor from the summation to get the square of deviations for the total variance:

$$\text{Sum of squares of Deviations for total variance or total SS} = \sum X_{ij}^2 - \frac{(T)^2}{n}.$$

v) After the above step, calculate the total of all the different columns, and then calculate the square of sum of every column. Then divide the square value of the each column by the corresponding number of items in that column and again get the sum of that particular column. Now, subtract the above calculated correction factor from this total. So the output received is the sum of the squares of deviation for the variance between the columns (SS between columns).

vi) In this step, the researcher calculates the total rows and then finds out the 'square of sum of every row'. This squared sum is then divided by the number of items of that specific row to obtain the sum of that entire row. Now, correction factor is subtracted from the calculated sum and the researcher gets 'sum of the square of the deviation for variance between the columns (SS between columns)'.

vii) Here by subtracting the sum of 5th and 6th step from 4th step researcher can calculate the sum of the squares of the deviation for the error or residual variance.

Total SS – (SS between columns + SS between rows) = SS for residual or error variance

Degrees of freedom (d.f.) can be worked out as under:

d.f. for Total Variance = (c. r – 1)

d.f. for Variance between Columns = (c –1)

d.f. for Variance between Rows = (r – 1)

d.f. for Residual Variance = (c – 1) (r – 1)

Where, c = Number of Columns

r = Number of Rows

viii) ANOVA table can set up as:

Analysis of Variance Table for Two way ANOVA

Source of Variation	Sum of Squares (SS)	Degrees of the Freedom (d.f.)	Mean Square Value (MS)	F-Ratio Value
Between the columns Treatment	$\sum \frac{(T_j)^2}{n_j} - \frac{(T)^2}{n}$	(c – 1)	$\frac{SSB(columns)}{(c-1)}$	$\frac{MSB(columns)}{MSR}$
Between the rows Treatment	$\sum \frac{(T_i)^2}{n_i} - \frac{(T)^2}{n}$	(r – 1)	$\frac{SSB(columns)}{(r-1)}$	$\frac{MSB(rows)}{MSR}$
Residual or error	Total SS – (SS between the columns + SS between the rows)	(c – 1) (r – 1)	$\frac{SSR}{(c-1)(r-1)}$	
Total	$\sum x_{ij}^2 - \frac{(T)^2}{n}$	(c.r –1)		

Where c = Number of the Columns

r = Number of the Rows

SSR (SS residual) = Total SS – (SS between the columns + SS between the rows).

The basis for F-ratio is provided by the Mean Square Residual (MSR) or residual variance. It is concerned with the variations that are between the column and the row calculation. The fluctuations in the sampling always cause the Mean Square residual. The two F-ratios are than compared with the related table values, for a given degree of the freedom at specified significance level. If the calculated value for the F-ratio is greater than or equal to the table value, in that case, difference of column means is treated significant. In the same way the F-ratio related to the variations between the rows can be calculated.

2) **ANOVA Technique in the Context of Two–Way Design when Repeated Values are there:** The researcher gets the separate value of the individual smallest change or variation, in the case of the two way ANOVA, when there are some repeated values. The degree of freedom and sum of the squares are calculated for the variance within the sample same as in case of one way ANOVA. The total sum of the square (SS), which are between the columns and the rows, can be calculated as stated above. Later, the

researcher finds out the 'left over sums of the square' and also the 'left over degree of freedom' which is known as the 'interaction variation'. (Interaction variation is the value of the relationship present between two different classifications). After all the calculations have been done, ANOVA table can be set up for observing various inferences.

Example 2: 5 doctors each test 5 treatments for a certain disease and observe the number of days each patient takes to recover. The results are given in below table. Discuss the difference between

1) The doctors, and
2) The treatment.

Use $\alpha = 0.05$.

Doctors	Treatments				
	1	2	3	4	5
1	10	14	23	18	20
2	11	15	24	17	21
3	9	12	20	16	19
4	8	13	17	17	20
5	12	15	19	15	22

Solution: We subtracted 15 from the given values and work out with the new values of x_{ij}.

Doctors	Treatments					
	1	2	3	4	5	Total
1	−5	−1	8	3	5	10
2	−4	0	9	2	6	13
3	−6	−3	5	1	4	1
4	−7	−2	2	2	5	0
5	−3	0	4	0	7	8
Total	−25	−6	28	8	27	32

Correction Factor $= \frac{T^2}{N} = \frac{(32)^2}{25} = 40.96$ (Where number of observations or N is 25)

Sum of Squares between Columns (Treatments)

This will be obtained by squaring the treatments totals, dividing each total by the number of observations included in it, adding these figures and then subtracting the correction factor from them. Thus, sum of squares between salesmen is:

$$= \frac{(-25)^2}{5} + \frac{(-6)^2}{5} + \frac{(28)^2}{5} + \frac{(8)^2}{5} + \frac{(27)^2}{5} - \frac{T^2}{N}$$

$$= 125 + 7.2 + 156.8 + 12.8 + 145.8 - 40.96 = 406.64$$

Degrees of Freedom $(v) = (5 - 1) = 4$

Sum of Squares between Rows (Doctors)

This will be obtained by dividing the squares of the doctors totals by the number of observations that make-up each total, adding all such figures and subtracting these from the correction factor. Thus, sum of squares between doctors is:

$$= \frac{(10)^2}{5} + \frac{(13)^2}{5} + \frac{(1)^2}{5} + \frac{(0)^2}{5} + \frac{(8)^2}{5} - \frac{T^2}{N} = 66.8 - 40.96 = 25.84.$$

Degrees of Freedom $(v) = (5 - 1) = 4$

Total Sum of Squares

This will be obtained by adding the squares of all the observations in the table and subtracting the correction factor therefrom. Thus, total sum of squares is:

$= (-5)^2 + (-4)^2 + (-6)^2 + (-7)^2 + (-3)^2 + (-1)^2 + (0)^2 + (-3)^2 + (-2)^2 + (0)^2 + (8)^2 + (9)^2 + (5)^2 + (2)^2 + (4)^2 + (3)^2 + (2)^2 + (1)^2 + (2)^2 + (0)^2 + (5)^2 + (6)^2 + (4)^2 + (5)^2 + (7)^2 - \frac{T^2}{N}$

$= 25 + 16 + 36 + 49 + 9 + 1 + 0 + 9 + 4 + 0 + 64 + 81 + 25 + 4 + 16 + 9 + 4 + 1 + 4 + 0 + 25 + 36 + 16 + 25 + 49 - 40.96 = 508 - 40.96 = 467.04$

$v = (25 - 1) = 24$

The above information is presented in the following table:

ANOVA Table

Source of Variation	Sum of Squares	d.f.	Mean Square	F-Ratio
Between columns (Treatments)	406.64	4	101.66	$\frac{101.66}{2.16} = 47.06$
Between rows (Doctors)	25.84	4	6.46	$\frac{6.46}{2.16} = 2.99$
Residual	34.56	16	2.16	
Total	**467.04**	**24**		

The table value of F for 4 and 16 degrees of freedom at 5% level of significance is 3.01.

1) Table value of F is greater than the calculated value for doctors. Hence there is not any difference between doctors.
2) Table value of F is less than the calculated value for doctors. Hence there is highly significant difference between treatments.

4.4. MULTIVARIATE ANALYSIS

4.4.1. Introduction

Complexity is increased when researcher uses the multiple independent and multiple dependent variables in the research. Due to this reason, multivariate analysis is widely used by the researcher to solve the research problem. The statistical technique which are emphasised upon, and bring out in bold relief, the organisation of instantaneous associations among three or more phenomena, is referred to as multivariate analysis. So, this technique is suitable when more than two variables are simultaneously analysed in the data analysis.

This analysis emphasises on the paired relationships to the more complex concurrent relationship among three or more than three phenomena and bivariate analysis emphasises on the degree of the relationships (correlation or covariance) between phenomena. On the other hand, univariate analysis emphasises on the level (average) and distribution (variance) of the phenomena.

4.4.2. Multivariate Statistical Techniques

Multivariate statistical techniques can be broadly defined as "a collection of procedures for analysing the association between two or more sets of measurements that were made on each object in one or more samples of objects". If only two sets of measurements are involved, the data typically are referred to as bivariate. The multivariate techniques can be classified based on the following logic:

1) Can the data be partitioned into dependent and independent variable sets? If so, classify according to the number of variables in each set. If not, classify the technique as an inter-dependence technique.
2) In the case of inter-dependence techniques, classification is done based on the principal focus of the analysis. Is the focus on the object (person/thing/event) or is it on the variable?

Based on the first factor, the multivariate techniques can be broadly classified as dependence techniques or inter-dependence techniques. Dependence techniques are appropriate when one or more variables can be

identified as dependent variables and the remaining as independent variables. The appropriate choice of dependence techniques further depends on whether there are one or more dependent variables involved in the analysis.

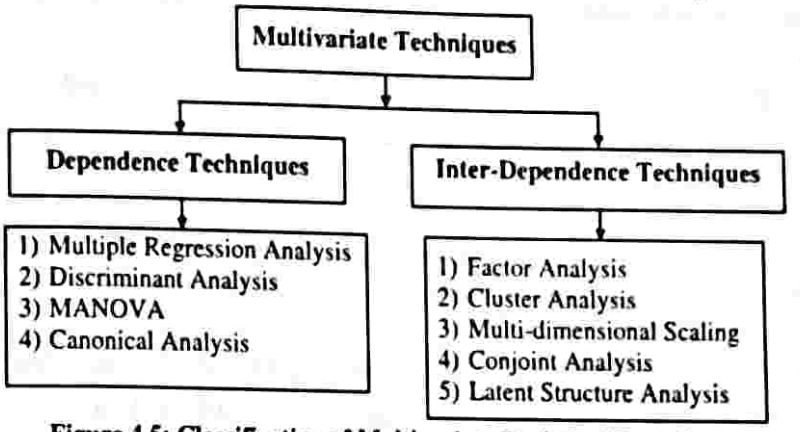


Figure 4.5: Classification of Multivariate Statistical Techniques

In inter-dependence techniques, the variables are not classified as dependent or independent; rather, the whole set of inter-dependent relationships is examined. The inter-dependence techniques can be further classified as focusing on variables or objects i.e., as variable inter-dependence or inter-object similarity techniques. **Figure 4.5** provides an overview of the various multivariate analysis techniques.

4.4.3. Multiple Regression and Correlation

Multiple regression analysis explains the logical extension of two-variable regression analysis. Multiple regression analysis uses two or more than two independent variables to evaluate the value of a dependent variable.

In **multiple correlation** it is assumed that the dependent variable is relate to a number of independent variables and the degree of association between the dependent variable and a number of independent variables, taken together, is measured. In statistics, the coefficient of **multiple correlation** is a measure of how well a given variable can be predicted using a linear function of a set of other variables. It is measured by the coefficient of determination, but under the particular assumptions that an intercept is included and that the best possible linear predictors are used, whereas the coefficient of determination is defined for more general cases, including those of nonlinear prediction and those in which the predicted values have not been derived from a model-fitting procedure.

4.4.3.1. Multiple Regression

Three or more variables, such as X_1, X_2, and X_3, are analysed in multiple regression analysis. Here, X_1 is taken as a dependent variable and its relative movement is found out, according to the movement in both independent variables X_2 and X_3. Thus, the effect of two or more independent variables on one dependent variable is studied in the 'multiple regression analysis'. The procedure for studying multiple regression is similar to simple regression, but there is a single difference that the independent variable is more than one. If there are three variables, X_1, X_2 and X_3, the multiple regression will take the following form:

$$X_1 = a_{1.23} + b_{12.3} X_2 + b_{13.2} X_3 \qquad \ldots\ldots (1)$$

In the above equation there are three constraints. The subscript after the dot indicates the variables, which are held constant.

If X_2 and X_3 are 0 then $X_1 = a_{1.23}$

For multiple regression models with two independent variables the result is determined with the use of three simultaneous equations, with three unknown (b_0, b_1 and b_2) values.

Statistical software, such as SPSS, MINITAB, MS-EXCEL etc., are used in multiple regression models because this analysis involves lengthy calculations.

Objectives of Multiple Regression

Certain objectives of multiple regression are as follows:

1) Derivation of an equation which gives an idea of the dependent variable from two or more values of the independent variables,
2) Measurement of error when the basis of evaluation is the regression analysis, and
3) Measurement of variance in the dependent variable with respect to the independent variables.

Assumptions of Multiple Regression Analysis

Following are the assumptions of multiple regression analysis:

1) The dependent variable should be a random variable whereas the independent variable need not be random variable,
2) The relationship between various independent variables and dependent variable is linear, and
3) The variances of the conditional distributions of the dependent variable and various combinations of values of the independent variables are all equal. The conditional distributions for the dependent variable follows the normal probability distribution.

Steps in Multiple Regression

1) State the research hypothesis.
2) State the null hypothesis.
3) Collect the data.
4) Calculate each variable separately (calculate measures of central tendency and dispersion, frequency distributions, graphs). Check, whether the variables are normally distributed or not.
5) Calculate the relationship between the dependent variable and the independent variables (find the correlation coefficient, obtain a scatter plot). Check, whether the variables are linearly correlated or not.
6) Calculate the relationship between all the independent variables with each other (calculate the correlation coefficient matrix for all the independent variables).
7) Calculate the regression equation from the data.
8) Calculate and examine appropriate measures of association and test of statistical significance for each coefficient as well as for the equation as a whole.
9) Accept or reject the null hypothesis.
10) Reject or accept the research hypothesis.
11) Explain the practical implications of the findings.

Methods of Calculation

1) **Multiple Regression Equations:** In case of simple regression, there is a regression line approximating a set of N points (X and Y) in a two-dimensional scatter diagram. Similarly, in case of multiple regression there exists a least square regression plane fitting a set of N points (X_1, X_2 and X_3) in a three dimensional scatter diagram:

   i) The regression plane of X_1 on X_2 and X_3 is represented by the equation (1),

   $$X_1 = a_{1.23} + b_{12.3} X_2 + b_{13.2} X_3 \quad \text{..... (1)}$$

   The values of $b_{12.3}$ and $b_{13.2}$ are determined by solving simultaneously the following three normal equations:

   $$\Sigma X_1 = Na_{1.23} + b_{13.2} \Sigma X_2 + b_{13.2} \Sigma X_3$$
   $$\Sigma X_1 X_2 = a_{1.23} \Sigma X_2 + b_{12.3} \Sigma X^2_2 + b_{13.2} \Sigma X_2 X_3$$
   $$\Sigma X_1 X_3 = a_{1.23} \Sigma X_3 + b_{12.3} \Sigma X_2 X_3 + b_{13.2} \Sigma X^2_3$$

   On multiplying X_2 and X_3 on both sides of equation (1), the last two normal equations are obtained.

   ii) The regression equation of X_2 on X_1 and X_3 would be as follows:

   $$X_2 = a_{2.13} + b_{21.3} X_1 + b_{23.1} X_3 \quad \text{..... (2)}$$

The normal equations for fitting the above equation are:

$$\Sigma X_2 = Na_{2.13} + b_{21.3}\Sigma X_1 + b_{23.1}\Sigma X_3$$
$$\Sigma X_1X_2 = a_{2.13}\Sigma X_1 + b_{21.3}\Sigma X_1^2 + b_{23.1}\Sigma X_1X_3$$
$$\Sigma X_2X_3 = a_{2.13}\Sigma X_3 + b_{21.3}\Sigma X_1X_3 + b_{23.1}\Sigma X^2_3$$

iii) The regression equation of X_3 on X_1 and X_2 would be as follows:

$$X_3 = a_{3.12} + b_{31.2}X_1 + b_{32.1}X_2 \quad \ldots\ldots (3)$$

The normal equations for fitting the above equation are:

$$\Sigma X_3 = Na_{3.12} + b_{31.2}\Sigma X_1 + b_{32.1}\Sigma X_2$$
$$\Sigma X_1X_3 = a_{3.12}\Sigma X_1 + b_{31.2}\Sigma X_1^2 + b_{32.1}\Sigma X_1X_2$$
$$\Sigma X_2X_3 = a_{3.12}\Sigma X_2 + b_{31.2}\Sigma X_1X_2 + b_{32.1}\Sigma X^2_2$$

Generalisation for more than three variables is as follows:

$$X_1 = a_{1.234} + b_{12.34}X_2 + b_{13.24}X_3 + b_{14.23}X_4$$

The four normal equations are determined by multiplying the above equation on both sides by X_1, X_2, X_3 and X_4 to find the values of $a_{1.234}$, $b_{13.24}$, $b_{12.34}$, and $b_{14.23}$.

2) **Deviations from the Mean:** If the deviations from the respective means of the various variables are taken into account, then the calculations for solving these equations can be reduced. Thus, if $X_1 = (X_1 - \overline{X}_1)$, $X_2 = (X_2 - \overline{X}_2)$ and $X_3 = (X_3 - \overline{X}_3)$, the multiple regression equation can be expressed as follows:

$$X_1 = b_{12.3}X_2 + b_{13.2}X_3$$

Following two normal equations are required to be solved, for determining the values of $b_{12.3}$ and $b_{13.2}$:

$$\Sigma X_1X_2 = b_{12.3}\sum X_2^2 + b_{13.2}\Sigma X_2\Sigma X_3$$
$$\Sigma X_1X_3 = b_{12.3}\Sigma X_2X_3 + b_{13.2}\sum X_2^2$$

The values of $b_{12.3}$ and $b_{13.2}$ can also be determined as follows:

$$b_{12.3} = r_{12.3} \times \frac{\sigma_{1.23}}{\sigma_{2.13}}; \qquad b_{13.2} = r_{13.2} \times \frac{\sigma_{13.2}}{\sigma_{3.12}}$$

Similar calculations are done for the regression equation of X_2 on X_1 and X_3 and for regression equation of X_3 on X_1 and X_2.

3) **Multiple Regression Equation of X_1 on X_2 and X_3:** It can be expressed as follows:

$$X - \overline{X}_1 = \frac{\sigma_1}{\sigma_2}\left[\frac{r_{12} - r_{13}\,r_{23}}{1 - r_{23^2}}\right](X_2 - \overline{X}_2) + \frac{\sigma_1}{\sigma_3}\left[\frac{r_{13} - r_{12}\,r_{23}}{1 - r_{23}^2}\right](X_3 - \overline{X}_3)$$

Similarly, the multiple regression equation of X_2 on X_3 and X_1 can be expressed as follows:

$$X_2 - \overline{X}_2 = \frac{\sigma_2}{\sigma_3}\left[\frac{r_{23} - r_{12}\,r_{13}}{1 - r_{13}^2}\right](X_3 - \overline{X}_3) + \frac{\sigma_2}{\sigma_1}\left[\frac{r_{12} - r_{23}\,r_{31}}{1 - r_{31}^2}\right](X_1 - \overline{X}_1)$$

Lastly, the multiple regression equation of X_3 on X_1 and X_2 would be expressed as follows:

$$X_3 - \overline{X}_3 = \frac{\sigma_3}{\sigma_2}\left[\frac{r_{23} - r_{12}\,r_{13}}{1 - r_{12}^2}\right](X_2 - \overline{X}_2) + \frac{\sigma_3}{\sigma_1}\left[\frac{r_{13} - r_{23}\,r_{12}}{1 - r_{12}^2}\right](X_1 - \overline{X}_1)$$

In this method, determination of regression equations is simple in comparison when the normal equations are required to be solved for determining the regression equations. Here we only need the following values.

X_1, X_2, X_3, $\sigma_1, \sigma_2, \sigma_3$ and r_{12}, r_{13}, r_{23}.

Example 3: Find the multiple regression equation of X_1 on X_2 and X_3 from the data relating to three variables given below:

X_1	4	6	7	9	13	15
X_2	15	12	8	6	4	3
X_3	30	24	20	14	10	4

Solution: The regression equation of X_1 on X_2 and X_3 is

$$X_1 = a_{1.23} + b_{12.3} X_2 + b_{13.2} X_3$$

The three normal equations to get the values of $a_{1.23}$, $b_{12.3}$ and $b_{13.2}$ are

$$\Sigma X_1 = Na_{1.23} + b_{12.3} \Sigma X_2 + b_{13.2} \Sigma X_3$$
$$\Sigma X_1X_2 = a_{1.23} \Sigma X_2 + b_{12.3} \Sigma X_2^2 + b_{13.2} \Sigma X_2X_3$$
$$\Sigma X_1X_3 = a_{1.13} \Sigma X_3 + b_{12.3} \Sigma X_2X_3 + b_{13.2} \Sigma X^2_3$$

X_1	X_2	X_3	X_1X_2	X_1X_3	X_2X_3	X_2^2	X_3^2
4	15	30	60	120	450	225	900
6	12	24	72	144	288	144	576
7	8	20	56	140	160	64	400
9	6	14	54	126	84	36	196
13	4	10	52	130	40	16	100
15	3	4	45	60	12	9	16
$\Sigma X_1 = 54$	$\Sigma X_2 = 48$	$\Sigma X_3 = 102$	$\Sigma X_1X_2 = 339$	$\Sigma X_1X_3 = 720$	$\Sigma X_2X_3 = 1{,}034$	$\Sigma X_2^2 = 494$	$\Sigma X_3^2 = 2{,}188$

Substituting the values in the normal equations:

$$6a_{1.23} + 48b_{12.3} + 102b_{13.2} = 54 \quad \ldots\ldots (1)$$
$$48a_{1.23} + 494b_{12.3} + 1034b_{13.2} = 339 \quad \ldots\ldots (2)$$
$$102a_{1.23} + 1034b_{12.3} + 2188b_{13.2} = 720 \quad \ldots\ldots (3)$$

Multiplying (1) by 8, we get

$$48a_{1.23} + 384b_{12.3} + 816b_{13.2} = 432 \quad \ldots\ldots (4)$$

Subtracting (2) from (4), we get

$$110\, b_{12.3} + 218b_{13.2} = -93 \quad \ldots\ldots (5)$$

Multiple (1) by 17, we get

$$102\, a_{1.23} + 816b_{12.3} + 1734b_{13.2} = 918 \quad \ldots\ldots (6)$$

Subtracting (3) from (6), we get

$$218\, b_{12.3} + 454b_{13.2} = -198 \quad \ldots\ldots (7)$$

Multiplying (5) by 109, we obtain

$$11990\, b_{12.3} + 23762\, b_{13.2} = -10137 \quad \ldots\ldots (8)$$

Multiplying (7) by 55, we get

$$11990\, b_{12.3} + 24970b_{13.2} = -10890 \quad \ldots\ldots (9)$$

Subtracting (8) from (9), we get

$$1208b_{13.2} = -753$$

$$\text{or } b_{13.2} = \frac{753}{1208} = -0.623$$

Substituting this value of $b_{13.2}$ in equation (5), we get

$$110\, b_{12.3} + 218\,(-0.623) = -93$$
$$110\, b_{12.3} = 135.814 - 93$$
$$b_{12.3} = \frac{42.814}{110} = +0.389$$

Substituting the values of $b_{12.3}$ and $b_{13.2}$ in equation (1), we get

$$6a_{1.23} + 48(0.389) + 102\,(-0.623) = 54$$
$$6a_{1.23} = 54 + 63.546 - 18.672 = 98.874$$
$$a_{1.23} = 16.479$$

Thus the required regression equation is:

$$X_1 = 16.479 + 0.389\,X_2 - 0.623\,X_3.$$

Application of Multiple Regression

Multiple regression can be applied in:

1) **Predicting the Future:** Future events and occurrences in the business can be predicted with the help of regression. **For example**, the number of units to be purchased by consumers in the future can be predicted by demand analysis. However, demand is among the many parameters in regression that is a dependent variable. The management can calculate the cost to be incurred on an advertisement if it is able to predict the number of consumers who are going to pass by a specific hoarding or the number of viewers who are going to watch the IPL match.

2) **Optimisation:** Business processes can be optimised with the help of regression models. **For example**, a model can be developed by a manager of a factory that would explain the relationship between the shelf life of biscuits and the temperature of ovens. Therefore, regression is considered as a vital tool for managers nowadays.

4.4.3.2. Multiple Correlation

Multiple correlation analysis is part of the multiple regression analysis, and under normal circumstances there is no need for a separate programme or algorithm. The multiple correlation programme is therefore used, when the primary data is unavailable, and analysis has to begin with only the correlation matrix being available. The results produced by this programme are therefore the partial correlation coefficient, the partial standardised correlation coefficient, and the multiple correlation coefficient. The programme also conducts step-wise deletion until only one independent variable remains. Here, we study the effects of all the independent variables simultaneously on a dependent variable.

For example, the correlation coefficient between the yield of paddy (X_1) and the other variables, *viz.*, type of seedlings (X_2), manure (X_3), rainfall (X_4), humidity (X_5) is the multiple correlation coefficient $R_{1.2345}$. This coefficient takes value between 0 and +1.

For example, we may wish to measure the relationship between the yield of wheat on the one hand and the amount of rainfall and temperature, taken together, at the other hand. In this case, yield of wheat is dependent variable and rainfall and temperature are independent variables. Thus, multiple correlation analysis helps us in measuring correlation between the dependent and the whole group of independent variables.

Properties of Multiple Correlation

The coefficient of a multiple correlation has a number of useful properties some of which may be cited here as under:

1) Its value ranges between 0 and 1 and it never results in a negative figure. Thus, $0 \leq R \leq 1$.
2) The position of the subscripts to the right of the dot does not make any difference. Thus, $R_{1.23} = R_{1.32}$, and $R_{2.134} = R_{2.341} = R_{2.431}$
3) If $r_{12} = 0$, and $r_{13} = 0$, then $R_{1.23} = 0$ and *vice versa*.
4) $R_{1.23} \geq r_{12}$, and r_{13}; $R_{2.13} \geq r_{12}$ and r_{23}, and $R_{3.12} \geq r_{13}$ and r_{23}. This property is useful for testing the consistency of the data.
5) The square of the coefficient of a multiple correlation gives the coefficient of a multiple determination.

Thus,

$$R^2 = \frac{\text{Explained variation}}{\text{Total variation}} = \text{Coefficient of multiple Determinaton.}$$

Objective of Multiple Correlation

The objective of a correlation analysis is to see whether two measurement variables co vary, and to quantify the strength of the relationship between the variables.

Methods of Calculation

The method of computation of a multiple correlation coefficient will depend upon the number of independent variables involved in the problem. If, the number of such variables is more than 3, it would involve a lot of complicacies in calculations, and in that case it would be advisable to make use of a computer. However, if such numbers remain within 3, the computations of such correlation coefficients can be done manually by the appropriate models given as below:

1) **When the Total Number of Independent Variables is 2:** In such a case we can have 3 multiple correlation coefficients as:
   i) $R_{1.23}$,
   ii) $R_{2.13}$, and
   iii) $R_{3.12}$ to be computed as follows:
      a) Multiple correlation between X_1 on the one hand, and X_2 and X_3

$$R_{1.23}=\sqrt{\frac{r_{12}^2+r_{13}^2-2r_{12}.r_{13}.r_{23}}{1-r_{23}^2}} \text{ or } =\sqrt{r_{12}^2+r_{13.2}^2\left(1-r_{12}^2\right)}$$

      b) Multiple correlation between X_2 on the one hand, and X_1 and X_3

$$R_{2.13}=\sqrt{\frac{r_{12}^2+r_{23}^2-2r_{12}.r_{13}.r_{23}}{1-r_{13}^2}} \text{ or } =\sqrt{r_{12}^2+r_{23.1}^2\left(1-r_{12}^2\right)}$$

      c) Multiple correlation between X_3 on the one hand, and X_1 and X_2

$$R_{3.12}=\sqrt{\frac{r_{13}^2+r_{23}^2-2r_{12}.r_{13}.r_{23}}{1-r_{12}^2}} \text{ or } =\sqrt{r_{13}^2+r_{23.1}^2\left(1-r_{13}^2\right)}$$

2) **When the Total Number of Independent Variables is 3:** In such a case, we can have 4 multiple correlation coefficients as:
   i) $R_{1.234}$,
   ii) $R_{2.134}$,
   iii) $R_{3.124}$, and
   iv) $R_{4.123}$.

   These coefficients will be calculated by the respective models as follows:

   i) $R_{1.234}=\sqrt{1-\left(1-r_{14}^2\right)\left(1-r_{13.4}^2\right)\left(1-r_{12.34}^2\right)}$

   ii) $R_{2.134}=\sqrt{1-\left(1-r_{24}^2\right)\left(1-r_{23.4}^2\right)\left(1-r_{12.34}^2\right)}$

   iii) $R_{3.124}=\sqrt{1-\left(1-r_{34}^2\right)\left(1-r_{23.4}^2\right)\left(1-r_{13.24}^2\right)}$, and

   iv) $R_{4.123}=\sqrt{1-\left(1-r_{34}^2\right)\left(1-r_{24.3}^2\right)\left(1-r_{14.23}^2\right)}$

Example 4: The following correlation coefficients are given for a trivariate data:

$r_{12}=0.98$, $r_{13}=0.44$ and $r_{23}=0.54$.

Calculate the multiple correlation coefficients treating the first variable as dependent and the second and third variables as independent.

Solution: $R_{1.23}$ = Multiple correlation between X_1 on the one hand, and X_2 and X_3 on the other is given by equation

$$R_{1.23}=\sqrt{\frac{r_{12}^2+r_{13}^2-2_{12}r_{13}r_{23}}{1-r_{23}^2}}$$

$$R_{1.23}=\sqrt{\frac{(0.98)^2+(0.44)^2-2(0.98)(0.44)(0.54)}{1-(0.54)^2}}=+0.986$$

Example 5:

i) Given that $r_{12} = 0.6$, $r_{13} = 0.7$ and $r_{23} = .65$ determine $R_{1.23}$. Calculate also the partial correlation coefficient $r_{23.1}$

ii) If $R_{1.23} = 0$ does it follow that $R_{2.13} = 0$.

iii) If $R_{1.23} = 1$ does it follow that $R_{2.13} = 1$.

Solution:

i) $$R_{1.23} = \sqrt{\frac{r_{12}^2 + r_{11}^2 - 2r_{12}r_{13}r_{23}}{1 - r_{23}^2}}$$

$$= \sqrt{\frac{(0.6)^2 + (0.7)^2 - 2(0.6)(0.7)(0.65)}{1 - (0.65)^2}} = 0.726$$

$$r_{23.1} = \frac{r_{23} - r_{12}r_{13}}{\sqrt{(1 - r_{12}^2)(1 - r_{13}^2)}} = \frac{0.65 - (0.6) \times (0.7)}{\sqrt{(1 - 0.6^2)(1 - 0.7^2)}} = 0.403$$

ii) If $R_{1.23} = 0$ then $r_{12}^2 + r_{13}^2 - 2r_{12}r_{13}r_{23} = 0$

i.e., $r_{12}^2 + r_{13}^2 - 2r_{12}r_{13}r_{23} = 0$

The value of $R_{2.13}^2 = \frac{r_{12}^2 + r_{13}^2 - 2r_{12}r_{13}r_{23}}{1 - r_{13}^2}$

Putting in above

$$R_{2.13}^2 = \frac{r_{12}^2 + r_{21}^2 - r_{12}^2 - r_{13}^2}{1 - r_{13}^2} = \frac{r_{21}^2 - r_{13}^2}{1 - r_{13}^2}$$

So it is not necessary that this value is zero. In fact it will have some positive value.

iii) If $R_{1.23}^2 = 1$ then $r_{12}^2 + r_{13}^2 - 2r_{12}r_{13}r_{23} = 1 - r_{23}^2$

or $r_{12}^2 + r_{23}^2 = 1 - r_{13}^2 + 2r_{12}r_{13}r_{23}$

The value of $R_{2.13}^2 = \frac{1 - r_{13}^2 - 2r_{12}r_{13}r_{23} - 2r_{12}r_{13}r_{23}}{1 - r_{13}^2}$

Hence if $R_{1.23} = 1$, then $r_{2.13}$ will definitely be 1.

Application of Multiple Correlation

Certain applications of multiple correlation are as follows:

1) The nature, direction and extent of relationship among variables can be studied with the help of correlation.
2) One can estimate the change in the value of a variable due to change in the value of other related variable with the help of correlation. This study is referred to as regression analysis.
3) Behaviour of certain events in particular situations can be understood with the help of correlation studies. **For example**, one can easily recognise the factors causing rainfall in a region and the way such factors affect the production of rice.
4) Business decision-making is improved and uncertainty is reduced with the help of correlation.
5) One can make predictions with the help of correlation.

4.4.4. Discriminant Analysis

The number of categories which is possessed by the criterion variable describes the discriminant analysis technique. If there are two categories involved in the criterion variable then the technique is called **two-group discriminant analysis**. If there are three or more categories involved in the criterion variable then the technique is called **multiple discriminant analysis**.

The researchers are facilitated in the discriminant analysis to classify the persons or objects into two or more categories. **For example,** consumers can be classified as loyal and switchers. With the use of this technique the ategories or classes can be predicted which are mutually exclusive and in which individuals are possible to be ncluded. In many cases, the classification will be dichotomous such as user and non-users, high and low, and so on.

For classifying the subjects into group the discriminant analysis is widely used as a predictive tool. For this purpose discriminant analysis is used for creating a linear combination of a set of dependent variables so that the different levels of the dependent variable (categories) differ as widely as possible. Discriminant analysis is very similar to the multiple regression because in both techniques dependent variables are predicted with the help of a linear combination of continuous independent variables.

There is a basic difference in both techniques; in multiple regression analysis is used to predict the continuous dependent variable. On the other hand discriminant analysis is used to predict atleast two but generally three or more levels of categorical dependent variables (e.g., high performers/moderate performers/low performers, certification success/failure, employees who stay for two years or less/employees who stay for five years/employees who stay for ten or more years, etc.).

4.4.4.1. Objectives of Discriminant Analysis

The objectives of discriminant analysis are as follows:

1) Development of discriminant functions, or linear combinations of the predictor or independent variables, which will best discriminate between the categories of the criterion or dependent variable (groups).
2) Examination of whether significant differences exist among the groups, in terms of the predictor variables.
3) Determination of which predictor variables contribute to most of the intergroup differences.
4) Classification of cases to one of the groups based on the values of the predictor variables.
5) Evaluation of the accuracy of classification.

4.4.4.2. Steps in Discriminant Analysis

Following steps are required to be taken in discriminant analysis:

1) **Formulation of the Problem:** Formulation of the problem is the first and foremost step in discriminant analysis. For this, it is essential to determine the criterion and independent variables alongwith determining the objectives. Here, the criterion variable should have two or more collectively exhaustive categories or they must be mutually exclusive in nature. As the suitable cut-off points are determined for each category, the distribution of dependent variables can be estimated and groups of equal sizes can be formed. Theoretical model or previous research results should be used to select the predictor variables. However, in case of exploratory research, the selection procedure can be guided by an experienced researcher.

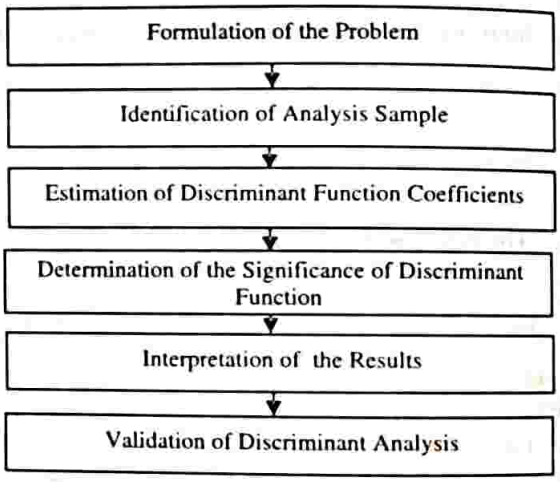

Formulation of the Problem
Identification of Analysis Sample
Estimation of Discriminant Function Coefficients
Determination of the Significance of Discriminant Function
Interpretation of the Results
Validation of Discriminant Analysis

Figure 4.6: Steps in Discriminant Analysis

2) **Identification of Analysis Sample:** In the next step, the sample is divided into two parts, i.e., estimation or analysis sample and holdout or validation sample. Analysis sample is used for evaluating the discriminant function whereas the validation sample is used to validate the discriminant function. Once the evaluation and validation is completed, the roles of these two samples are inter-changed and again the discriminant function is evaluated and validated. This is also known as double cross-validation.

3) **Estimation of Discriminant Function Coefficients:** The next step is the estimation of discriminant function coefficients. Two major approaches can be used to estimate the discriminant function coefficients:
   i) **Direct Approach:** In this, all the predictor variables are entered at once in the discrimination irrespective of their discriminating ability. This method is suitable when the analyst depends upon the results of previous research or theoretical conclusion.

ii) **Alternative Approach:** In this, the predictor variables are not entered simultaneously in the discrimination, but one by one. They are entered as per their discriminating ability. This procedure is suitable for the analyst who intends to find a sub set of predictable variables to include in discriminant function.

4) **Determination of the Significance of Discriminant Function:** The next step in discriminant analysis is the determination of the significance of discriminant function. The interpretation of analysis remains meaningless if the estimated discriminant functions are statistically insignificant. Therefore, with the help of suitable statistical tools the estimation of significance of discriminant function is done.

5) **Interpretation of the Results:** In the next step the results are interpreted. Interpreting the coefficients or discriminant weights is undertaken in same way as in multiple regression analysis. The coefficient values of predictors are affected by presence of each other. Although, the signs of the coefficients are random, yet the coefficients can indicate which variable will result in large and small function value and help to allocate a particular group.

6) **Validation of Discriminant Analysis:** In this step the classification matrix is developed. The validation sample is used here. The predictor variable values of the validation sample are multiplied by discriminant weights of the analysis sample. In this way, the discriminant scores are developed for the cases in the validation sample. Based upon a decision rule and the values of the discriminating scores the cases are assigned to different groups. The cases which are correctly classified are determined. This is further compared with rate of probability classification.

4.4.4.3. Methods Involved in Discriminant Analysis

Different methods involved in discriminant analysis are as follows:

1) **Multiple Discriminant Analysis (MDA):** This method is also known as Canonical Discriminant Analysis or Discriminant Factor Analysis. The viewpoint of this method is same as that of the Principal Components Analysis (PCA), however, the working principle of PCA and MDA are different. PCA highlights the variance of all variables considered by the factor, whereas, the difference between the dependent variables are highlighted by the MDA.

   In terms of geometry, the rows of the data matrix are represented as points in multidimensional space, as well as the group mean vectors. Here, optimal separation of predefined group is attained by determining the discriminating axis in this multidimensional space. The difference between the values of the dependent variable is maximised by the first discriminant function. However the second function is not correlated to first function and the differences between dependent variable values are maximised by it. This keeps going.

2) **Fisher's Linear Discriminant Analysis (LDA):** The 2-group case of MDA is known as Linear Discriminant analysis. Considering the equal class covariance matrices, the separating decision surface of LDA is similar to Bayesian maximum likelihood discrimination, i.e., linear.

3) **K-Nearest Neighbours (K-NN) Discriminant Analysis:** In order to draw out the probability density function assumptions, Non-parametric (distribution-free) methods are given out. They have gained enormous popularity and are commonly adopted in image processing area. In this, a particular object, having certain affiliation (unknown) to the group, to which most of its (the object's) K nearest neighbours is associated, is assigned.

It is very difficult to mark a method as best one. The different advantages and disadvantages of these methods are as follows:

1) NN-rule or linear discriminant analysis is preferred due to presence of computational reasons and analytical ease.
2) In order to analyse the pairs of multi-group data, 2-group method is repeatedly used.
3) More computation and data is needed in quadratic discrimination as compared to linear discrimination for evaluating the parameters required in it. Both linear and quadratic discriminations would be performed in case of absence of any significant difference between the group covariance matrices.
4) If covariance matrices as well as the sample means are not appropriately defined due to absence of sufficient data, K-NN method is used.
5) For feature selection, MDA is most suitable method. However in PCA, focus is primarily on the variables to establish difference between the groups, to add synthetic variables for improving the group ability of the data as well as to discard the irrelevant variables for the same purpose and to determine the parsimonious variables for representing them for graphical uses.

4.4.4.4. Applications of Discriminant Analysis

There are following five applications of discriminant analysis:

1) **Classifying and Describing Subjects:** This analysis provides means to classify and describe the subjects in two or more groups simultaneously.

2) **Tool for Improving the Quality:** Discriminant analysis tool is also used by political scientists for enhancing the quality of predictions made by them regarding the subjects and the groups they are belonging to.

3) **Determining Descriptive Variables:** For identifying the descriptive variables having the highest power to discriminate between two or more groups of people, researchers use this technique.

4) **Serves as Check for Diagnoses:** The discriminant analysis is used as a check test. In this, the diagnoses or predictions based on different evaluations are analysed.

5) **Gauge How Far Apart the Groups are Located:** This method is also useful for analysing/measuring that how far apart the groups are located on the basis of descriptive characteristics. This method is quite similar to the discrimination test. Here, the distance between groups is based on the location of the central tendency values associated with each group which is formed by the computer generated functions. These central tendency values are also known as centroids.

4.4.5. Factor Analysis

Factor analysis is a method which is used to investigate that a number of variables are linearly related to the small number of unavoidable factors or not. In this technique, observed variables are displayed as linear combinations of the factors, plus "error" terms.

With the help of the collected information about the inter-dependencies the set of variables are reduced in a data set. Factor analysis is created in psychometrics and is used in various areas of study that deal with the large amount of data such as behavioural sciences, social sciences, marketing, product management, operations research and other applied sciences.

Factor analysis and principal component analysis are related, but distinct. If the occurrence of "errors" in the factor analysis model is assumed due to the same variable then the factor analysis becomes essentially equivalent to principal component analysis.

The latent structure (dimensions) of a set of variables is uncovered with the help of factor analysis. Attribute space is reduced from a large number of variables to a smaller number of factors. Factor analysis is invented by Charles Spearman before a century ago for showing that a wide variety of mental tests could be explained by a single underlying intelligence factor.

4.4.5.1. Objectives of Factor Analysis

1) **Identify Underlying Dimensions, or Factors:** Identify the underlying factors which explain the correlation among a set of variables. **For example,** psychographic profiles of consumers are measured with the use of a set of lifestyle statements. For identifying the underlying psychographic factors these statements are then being factor analysed.

2) **Identify a New Smaller Set of Uncorrelated Variables:** For replacing the original set of correlated variables in subsequent multivariate analysis (regression or discriminant analysis), identify a smaller set of uncorrelated variables. **For example,** the psychographic factors which are identified can be used as independent variables for explaining the differences between loyal and non-loyal consumers.

3) **Identify a Smaller Set of Salient Variables:** For multivariate analysis identify a smaller set of relevant variables from a larger set of variables. **For example,** a smaller set of original lifestyle statements are selected which are highly correlated with the identified factors. The selected statements are used as independent variables for explaining the differences between the loyal and non-loyal users.

4.4.5.2. Steps in Factor Analysis

The steps involved in conducting factor analysis are shown in **figure 4.7.**

1) **Formulate the Problem:** Various tasks are included for formulating the problem. Identify the purpose of the factor analysis. On the basis of past research, theory and judgment of the researcher specify the variables which are included in the factor analysis. The selected variables must be properly measured on an interval or ratio scale. The suitable sample size must be used. The sample size should be atleast four or five times in respect to the available variables. This ratio would be lower in case of various marketing research in which the sample size is small. In these cases, the results should be interpreted carefully.

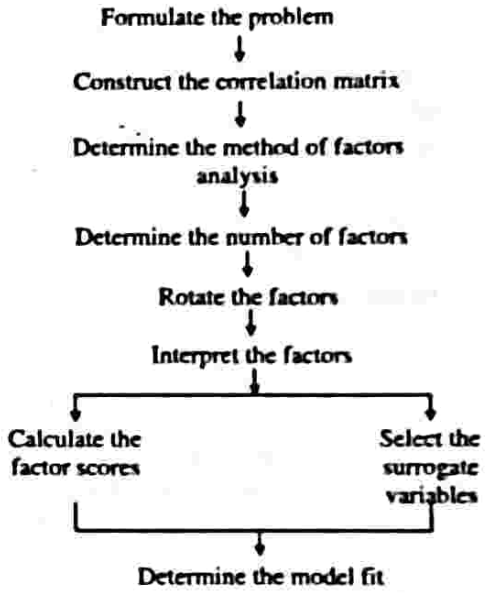

Formulate the problem
Construct the correlation matrix
Determine the method of factors analysis
Determine the number of factors
Rotate the factors
Interpret the factors
Calculate the factor scores
Select the surrogate variables
Determine the model fit

Figure 4.7: Steps in Factor Analysis

2) **Construct the Correlation Matrix:** A matrix of correlation between the variables is the basis of the analytical process. After proper analysis of this matrix important insights can be found. The variables must be correlated for the suitable factor analysis.

   The factor analysis would not be suitable if the correlation among all the variables is small. It is expected that the variables which are highly correlated with each other should also be correlated with the same factor or factors.

3) **Determine the Method of Factor Analysis:** When it is decided that the factor analysis is a suitable technique for the data analysis then appropriate method must be selected. Various methods of factor analysis are differentiated on the basis of the approach which is used to derive the weights or factor score coefficients. The two basic approaches are:

   i) **Principal Components Analysis:** In this approach the total variance in the data is considered. The unities are involved in the diagonal of the correlation matrix and full variance is conveyed into the factor matrix. When the analysis of data focuses to find the minimum number of factors then principal components analysis is used. These factors will account for maximum variance in the data for use in subsequent multivariate analysis. These factors are known as principal components.

   ii) **Common Factor Analysis:** In this approach, the common variance is the basis of estimated factors. Communalities are inserted in the diagonal of the correlation matrix. When the purpose of analysis is to identify the underlying dimensions and the common variance then this approach is used. This method is also known as principal axis factoring.

   Various approaches are also available for estimating the common factors. Methods of unweighted least squares, generalised least squares, maximum likelihood, alpha method and image factoring are included in this approach. Since, these methods are not simple and hence they are not recommended for inexperienced users.

4) **Determine the Number of Factors:** Following are various procedures which have been suggested for determining the number of factors:

   i) **A Priori Determination:** Sometimes on the basis of prior knowledge the researcher knows that how many factors are required and hence a number of factors are removed by the researcher to find the required number of factors. When the desired number of factors is removed then the process of extraction is stopped. For the easy implementation of this approach many computer programs allow the user to specify the number of factors.

   ii) **Determination based on Eigen Values:** In this approach, only those factors are included whose eigen values are greater than 1.0 and the other factors are not included in the model. The amount of variance which is associated with the factor is called eigen value. Hence, only those factors are included whose

variance is greater than 1. Due to the standardisation, the factors with variance less than 1.0 are no suitable for the analysis. This approach will result in a conservative number of factors if the available number of variables is less than 20.

iii) **Determination based on Scree Plot:** The plotting of the eigen values against the number of factors for removing the unnecessary factors is called scree plot. The number of factors is determined with the help of the shape of the plot. Typically, the plot has a distinct break between the steep slope of factors, with large eigen values and a gradual trailing-off associated with the rest of the factors. This gradual trailing-off is referred to as the scree. Experimental evidence indicates that the point at which the scree begins denotes the true number of factors. Generally, the number of factors determined by a scree plot will be one or a few more than that determined by the eigen value criterion.

iv) **Determination based on Percentage of Variance:** In this approach, determine the level of factors which is to be removed so that the cumulative percentage of variance extracted by the factors reaches a satisfactory level. The satisfactory level of variance depends upon the problem. It is suggested that the factors extracted should account for atleast 60% of the variance.

v) **Determination based on Split-Half Reliability:** Divide the sample in two equal parts and factor analysis is done on each half. Only factors which have high correspondence of factor loadings across the two sub-samples are retained.

vi) **Determination based on Significance Tests:** Determination of statistical significance of the separate eigen values is possible and hold only those factors that are statistically significant. There is a drawback of this approach with the large samples (size greater than 200) that many factors are likely to be statistically significant while with a practical viewpoint many of these account for only a small proportion of the total variance.

5) **Rotate Factors:** An important output found from the factor analysis is the factor matrix which is also called the factor pattern matrix. The coefficient contained by the factor matrix is used to express the standardised variables in terms of the factors. The correlations between the factors and the variables are represented by the coefficients, the factor loadings. The factor and the variable will be closely related if a coefficient is having a large absolute value. For interpreting the factors coefficient of the factor matrix can be used. The relationship between the factors and individual variables are represented by the initial or unrotated factor matrix. Since, the factors are correlated with many variables and hence it rarely results in factors that can be interpreted.

Different methods of rotation may result in the identification of different factors. They are

i) **Orthogonal Rotation:** If the axes are at right angle to each other then rotation will be orthogonal.

ii) **Varimax Rotation:** Number of variables are minimised with high loadings on a factor and hence it enhances the interpretability of the factors.

iii) **Oblique Rotation:** If the axes are not at right angle to each other then the rotation will be diagonal and the factors will be correlated. When factors in population are likely to be strongly correlated then the diagonal rotation should be used

6) **Interpret Factors:** Interpretation is facilitated with identification of the variables that have large loadings on the same factor. Interpretation of that factor can be done in terms of variables that has load high on it. Another utility of interpretation is to plot the variables using the factor loadings as coordinates. Those variables exist at the end of an axis which have high loadings on only that factor, and hence describe the factor. The variables have small loading on both the factors which are near the origin. The variables are related to both the factors which are not near any of the axes. The factors are labelled as undefined or general factors when they cannot be clearly defined in terms of the original variables.

7) **Calculate Factor Scores:** Factor scores can be calculated if required. Factor analysis has its own stand-alone value. Calculation of factor score for each respondent is useful in case when the purpose of factor analysis is to reduce the original set of variables to a smaller set of composite variables (factors) for use in subsequent multivariate analysis. A linear combination of the original variables is simply known as a factor. The factor scores for the i^{th} factor may be estimated as follows:

$$F_i = W_{i1}X_1 + W_{i2}X_2 + W_{i3}X_3 + \ldots + W_{ik}X_k$$

The weights or factor score coefficients which are obtained from the factor score coefficient matrix are used to combine the standardised variables. Various computer programs allow the researcher to get the factor scores. Calculation of factor scores is possible in the case of principal components analysis. These scores are not correlated in case of principal component analysis. These scores are estimated in common factor analysis and there is no guarantee that the factors will not be correlated with each other. In subsequent multivariate analysis the factor score can be used in the place of original variables.

8) **Select Surrogate Variables:** Sometimes, the researcher wants to select the surrogate variables instead of computing factor scores. Selection of substitute or surrogate variables involves singling-out some of the original variables for use in subsequent analysis. This allows the researcher to conduct subsequent analysis and results are interpreted in terms of original variables rather than factor scores. The variable for each factor with the highest loading on that factor can be selected by examining the factor matrix. For the associate factor these factors are used as a surrogate variable. If one factor loading for a variable is clearly higher than all other factor loadings then the process will work well. If two or more variables have similar high loadings then the choice will not be easy. In such a case, the choice between these variables should be based on theoretical and measurement considerations.

9) **Determine the Model Fit:** The determination of model fit is the first step in the factor analysis. The observed correlation between variables can be attributed to common factors is the basic assumption in the factor analysis. Hence, the correlations between the variables can be deduced or reproduced by the estimated correlations between the variables and the factors. To determine model fit examines the differences between the observed correlations (as given in the input correlation matrix) and the reproduced correlations (as estimated from the factor matrix). These differences are called residuals. If there are many large residuals, the factor model does not provide a good fit to the data and the model should be re-considered.

4.4.5.3. Applications of Factor Analysis

1) To reduce a large number of variables to a smaller number of factors for data modeling.
2) To validate a scale or index by demonstrating that its constituent items load on the same factor and to drop proposed scale items which cross-load on more than one factor.
3) To select a subset of variables from a larger set, based on which original variables have the highest correlations with the principal component factors.
4) To create a set of factors to be treated as uncorrelated variables as one approach to handling multi-collinearity in such procedures as multiple regression.

4.4.6. Cluster Analysis

Like factor analysis and multi-dimensional scaling, cluster analysis is also an independent technique. It does not make any difference between dependent and independent variables. High internal (within cluster) homogeneity and high external (between-cluster) heterogeneity should be exist.

In marketing research, the use of cluster analysis is increasing rapidly due to the importance of this analysis in solving the problem of classifying consumers, products, etc. Market segmentation is generally not based on one factor but multiple factors. Generally, each variable represents its own cluster. It is a challenge to find a way to combine variables for the formation of relatively homogeneous clusters. These clusters should be internally homogenous and externally heterogeneous. Cluster analysis is an approach to achieve this goal. Examine the entire set of interdependent relationships. It is the technique which is similar to multi-dimensional scaling because in both techniques the similarity in inter-object is examined by examining the complete set of interdependent relationships.

There is a basic difference in both the techniques that multi-dimensional scaling identifies underlying dimensions and cluster analysis identifies clusters. Cluster analysis is opposite of factor analysis. In factor analysis number of variables is reduced by grouping them into a smaller set of factors while in cluster analysis number of observation or cases are reduced by grouping them into a smaller set of clusters.

4.4.6.1. Objectives of Cluster Analysis

1) **Reduction of Data:** Number of cases is reduced by allowing the consideration of several types of records instead of numerous records.

2) **Assign Observation to Groups:** Assignment of the observation to groups ("cluster") is the main objective of cluster analysis. After this all the observations within each group would be similar to one another with respect to variables or attributes of interest. Formulated groups should also be different from one another.

3) **Discover Composition of Groups:** In the classification problem where it is known that each observation belongs to a number of groups and the purpose is to predict the group to which a new observation belongs. Cluster analysis searches to discover the number and composition of the groups.

4.4.6.2. Steps in Cluster Analysis

Figure 4.8 depicts the process which can be followed while conducting the cluster analysis. Formulation of clustering problem by defining the variables on which clustering will be dependent will be the first step of this process. After this, selection of suitable distance measure would be done. The similarity or dissimilarity of different objects which are to be clustered is expressed by the distance measure. Different methods have been developed for clustering and the most effective method should be chosen by the researcher which can solve the problem effectively.

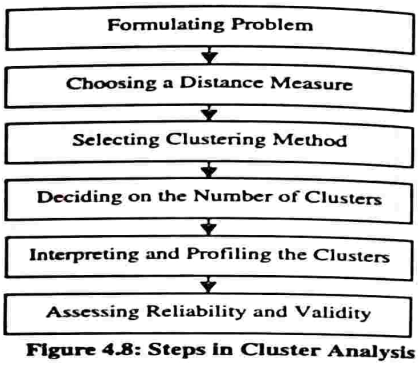

Formulating Problem
Choosing a Distance Measure
Selecting Clustering Method
Deciding on the Number of Clusters
Interpreting and Profiling the Clusters
Assessing Reliability and Validity

Figure 4.8: Steps in Cluster Analysis

The researcher has to make judgement for deciding the number of clusters. The clusters which are obtained should be expressed in terms of variables which are used in clustering them and different salient variables should be used for their profiling. The validity of clustering process must be determined by the researcher in the last step. All these steps are briefly described below:

1) **Formulating Problem:** Selection of variables on which the clusters are dependent can be considered as the most significant step in the cluster problem formulation. A useful clustering solution can become completely irrelevant due the presence of even one irrelevant variable. In fact, the similarity between various elements with respect to the relevance of the research problem should be represented by the set of variables selected. The considerations of the hypotheses being analysed, the past research or the theory may be utilised as basis for selecting the clustering variables. Judgement and institution can be used by the researcher in case of an exploratory research.

2) **Choosing a Distance Measure:** As the main objective of clustering process is to form the groupings of similar objects, there is a need of some measure to determine the extent of similarities or dissimilarities of objects. This measure is called the distance or similarity measure. Finding out the similarity in terms of distance between pairs of objects can be seen as the most popular method.

   There will be greater similarities between those objects which have lesser distance from each other in comparison to those objects which are having greater distance. Euclidean distance or its square is the method which is used most widely for similarity determination. The square root of the sum of the squared differences in values for each variable is known as Euclidean distance.

3) **Selecting Clustering Method:** Various clustering methods are presented in **Figure 4.9.** The clustering methods can be of following types:
   i) **Hierarchical Clustering:** A tree like structure or hierarchy is developed in this type of clustering. These can be of following types:
      a) **Agglomerative Clustering:** Agglomerative clustering can be initiated by having each object in different cluster. Now these objects are grouped to form a single big cluster. In this way, a giant cluster is formed including all the objects. This type of clustering is very common in marketing research.
         - **Linkage Methods:** The following types of linkages are used in linkage method:
           - **Single Linkage:** The nearest neighbour or minimum distance rule is the governing principle in case of single linkage method.

- **Complete Linkage:** There is similarity between the single linkage and complete linkage method but the only difference is that the principle of maximum distance or farthest neighbour is adopted in case of complete linkage. The distance between two clusters is measured in terms of distances between their two farthest points in case of complete linkage.

- **Average Linkage:** There is no difference in the functionality of average linkage. The only difference is that the distance between the two clusters is presented in terms of average of the distance between all pairs of objects in which the member of pairs are taken from each of the clusters.

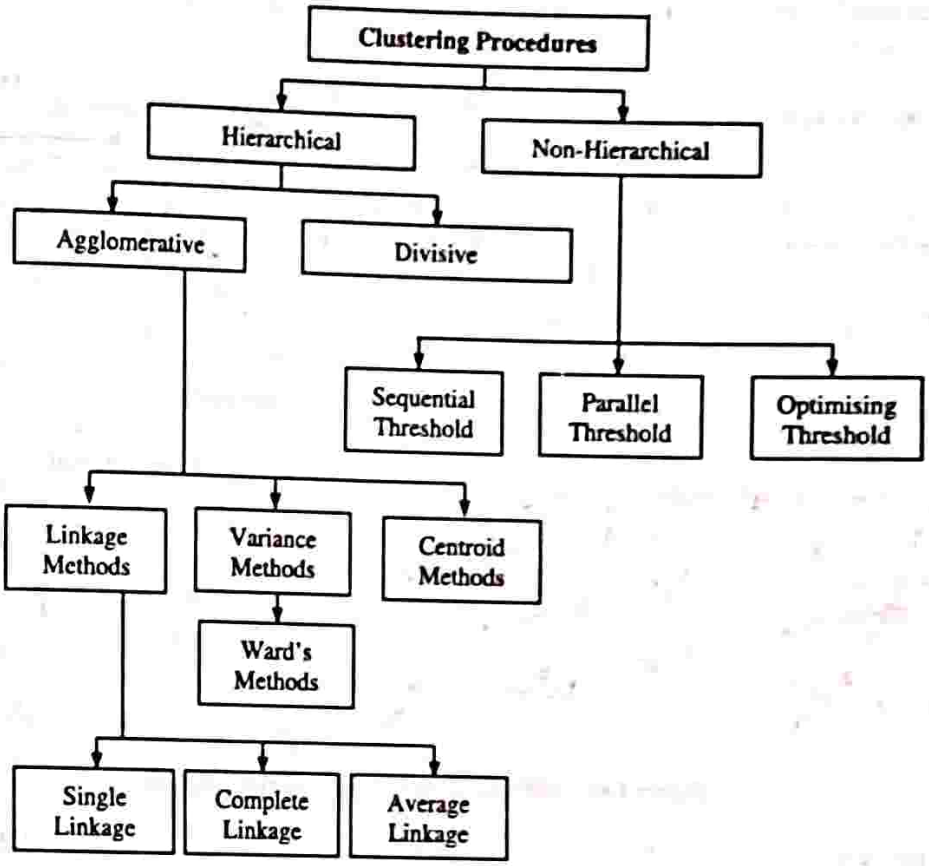


Figure 4.9: Classification of Clustering Procedures

- **Error Sums of Squares or Variance Methods:** Creating clusters which can reduce the with-in cluster variance is the main objective of variance methods. Ward's procedure is the most widely used variance method. The means of all the variables are determined for every cluster (**figure 4.11**). After computing the means, one has to calculate the squared Euclidean distance to the cluster means for every object. These distances for all the objects are summed now. Within cluster distances, the clusters having the smallest increment in the overall sum of squares are united at each stage.

- **Centroid Methods:** The distance between the centroids can be used for determining the distance between the clusters in case of centroids methods (**Figure 4.11**). It is meaningful for all the variables. The computation of new centroids will be done whenever the objects are combined.

b) **Divisive Clustering:** In this type of clustering, first all the objects are clustered in a single cluster. Then, this cluster starts dividing to form small clusters having objects. This process continues till each of the objects is in separate cluster.

ii) **Non-Hierarchical:** The Non-hierarchical clustering can be seen as the second method which can be used for clustering and it is also known as 'k-means clustering'. The following methods are included in this:

a) **Sequential Threshold Method:** In this the threshold value of a cluster centre is utilised for clustering the objects. First of all, a particular cluster centre or seed is selected and then different

objects lying in its pre-defined threshold value are clustered. Again a new cluster centre is chosen and different objects lying in its threshold value are grouped. This process is repeated until all the objects are clustered to the respective cluster centres. Any object which has already being clustered with a seed will not be considered for clustering in further seeds.

b) **Parallel Threshold Method:** The working of this method is same as the cluster centre method, the only difference is that the cluster centres are not selected sequentially but simultaneously and the objects get clustered to the nearest centre as per its threshold value.

c) **Optimising Partitioning Method:** This is very different from the above two methods. In this, the clustered objects can be re-assigned to different cluster centre so as to optimise the within-cluster distance.

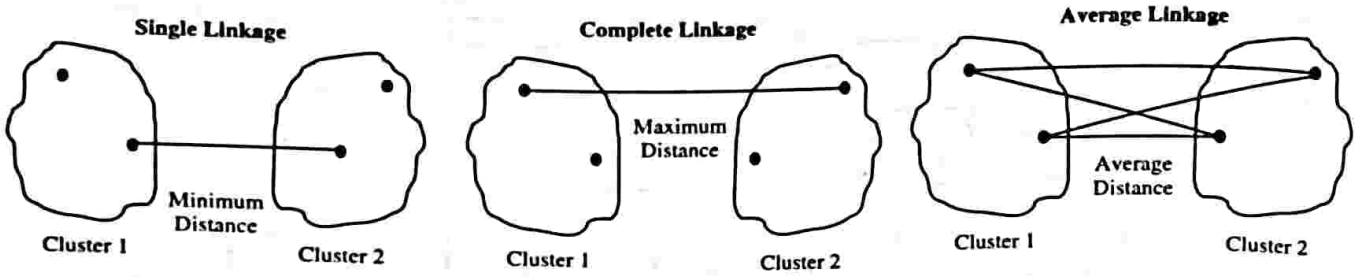


Figure 5.10: Linkage Methods of Clustering

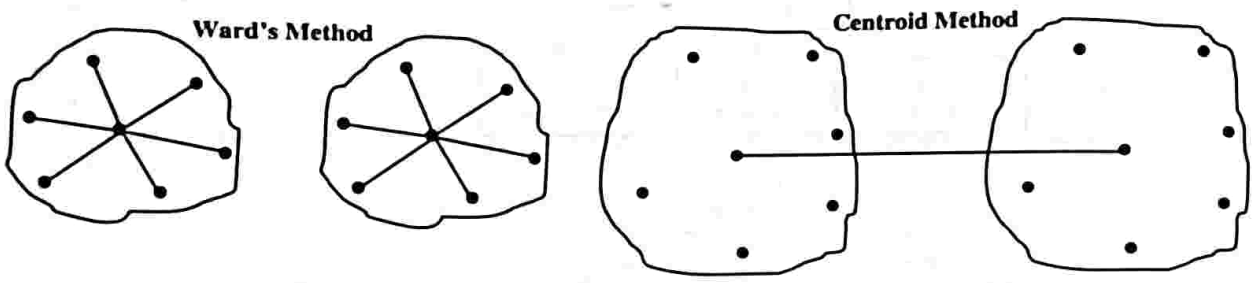


Figure 4.11: Other Agglomerative Clustering Methods

4) **Deciding on the Number of Clusters:** It is very crucial in cluster analysis to determine the number of clusters. No fixed method is available to determine the number of clusters; however, general guidelines are available for it. These are as follows:
   i) Depending upon the conceptual, practical or theoretical considerations, the numbers of clusters are different. **For example**, a certain number of clusters may be demanded by the management when the main objective of cluster is to identify various market segments.
   ii) In case of hierarchical method, the criteria for selecting the number of clusters can be chosen in the form of the distances at which clusters are grouped. Agglomeration schedule or dendrogram can be used to obtain this information.
   iii) In order to determine the number of clusters in case of non-hierarchical clustering, plotting of ratio of total 'within-group variance' to 'between-group variance' is done. The suitable number of clusters can be obtained at a point at which an elbow or a sharp bend occurs.
   iv) Clusters should have meaningful relative sizes.

5) **Interpreting and Profiling the Clusters:** Examination of cluster centroids is done for interpretation and profiling of clusters. The mean values of the objects are presented by the centroids which are contained in the clusters on every variable. By assigning a certain name of label to the clusters, we can describe each cluster with the help of centroids. Discriminate analysis can be used for this purpose if this information is not provided by the clustering programme.

6) **Assessing Reliability and Validity:** Without performing the assessment of the reliability and validity of the clustering, the clustering solution cannot be accepted as there are number of judgements involved in cluster analysis. There are lot of complexities in the formal process of determining the validity and reliability of

clustering solutions and these are not completely justifiable. Therefore, we do not consider them. In fact, the quality of clustering results can be controlled by undergoing following procedures:

i) Different distance measures should be applied in the same data for performing cluster analysis. In order to analyse the stability of the solution, the results of different methods should be compared.

ii) Clustering should be done by using different methods and then results should be compared.

iii) The data can be divided into two portions randomly and for each portion clustering should be performed separately. For two sub-samples, cluster centroids should be compared.

iv) Different variables are removed randomly. The clustering should be executed on the remaining set of variables. The comparison should be done between the results of clustering of remained variables and that of complete set of variables.

v) The solution of non-hierarchical clustering depends upon the order to cases in the data set. Until a stable solution is obtained, various runs are performed by using different order of cases.

4.4.6.3. Applications of Cluster Analysis

Market research utilises the cluster analysis in a large extent when they have data from surveys and test panels. In order to divide the market population into small distinctive market segments, cluster analysis is used by market researchers and this can also be helpful in having the better understanding of relationship between various groups of existing and potential customers. The various applications of cluster analysis are described below:

1) **Market Segmentation:** Segmenting the market can be seen as the area where cluster analysis is implemented profoundly. Identification of similar market segments is required by the marketing managers so that suitable marketing plans can be developed and special requirements of these segments can be satisfied. Classification of individuals, materials and so on into various grouped depending upon certain traits is done in this process.

2) **Customer Behaviour Analysis:** A better understanding of customer behaviour can be obtained with the help of cluster analysis. This can be done by determining the various homogeneous groups of customers.

3) **Development of New Products:** The activity of new product development can also be supported by cluster analysis. **For example,** by clustering different brands and products within the large market, various elements of competition can be analysed by the companies.

4) **Selection of Test Market:** This is mainly used to select the test markets.

4.4.7. Multi-Dimensional Scaling (MDS)

The process of representing perceptions and preferences of respondents spatially by means of a visual display is known as Multi-Dimensional Scaling (MDS). A geometric relationship among points in a multi-dimensional space which is also called spatial map represents the perceived relationships among stimuli. It is assumed that the psychological basis or underlying dimensions respondents use to form perceptions and preferences for stimuli are denoted by the axes of the spatial map. MDS has been used in marketing to identify:

1) The number and nature of dimensions consumers use to perceive different brands in the marketplace.
2) The positioning of current brands on these dimensions.
3) The positioning of consumers ideal brand on these dimensions.

To transform consumer decisions of similarity into distances represented in multidimensional space is the main purpose of MDS. This approach uses perceptual mapping to present the dimensions and is known as decompositional approach. It is useful in examining unrecognised dimensions about products because it is an exploratory technique. It displays the comparative evaluations of products when the basis for comparison is unknown. Typically there must be at least four times as many objects being evaluated as dimensions.

4.4.7.1. Objectives of MDS

MDS has following objectives:

1) **Develop Techniques of Full Text Analysis:** The development of appropriate techniques of full-text analysis and improving the efficiency of the individual methods in the mapping of science are the main objectives of multi-dimensional scaling (MDS). The MDS technique aims to represent the data in a two-dimensional or a three-dimensional space where the pair wise distances on the space approximates the actual distances.

2) **Provides Visual Presentation of Similarities:** It also gives a visual presentation of the similarities or dissimilarities (visual representation of proximities pattern) amongst the set of object data.

3) **Help Explain Observed Similarities:** The main objective of the technique is to understand the underlying dimensions in the data. These dimensions help the researcher to unearth the similarities or dissimilarities between various sets of data.

4) **Applied to Any Kind of Distances:** MDS can be applied to any kind of distances or similarities, whereas factor analysis requires us to first compute a correlation or covariance matrix.

4.4.7.2. Procedure/Steps in Multi-Dimensional Scaling

Since there are several types of data that can be used as input for MDS, a lot of care must be given by the researcher while formulating the MDS problem. A suitable form of data which has to be obtained should also be determined by the researcher alongwith the MDS process for data analysis.

Determination of various dimensions of the spatial map is one of the important aspects of the solution. Also, there must be proper labelling of the map axes and derived configuration. Moreover, the quality of the obtained result must be analysed by the researcher. The following steps will be included in a multi-dimensional scaling:

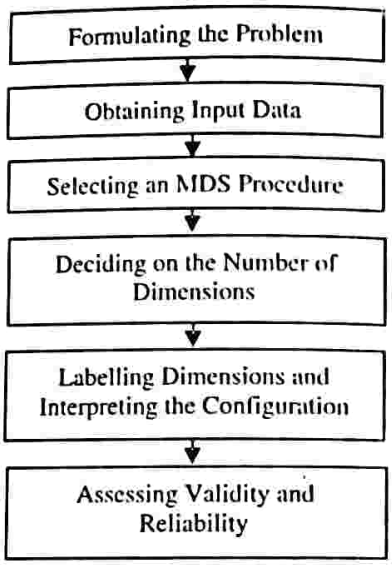

Formulating the Problem
Obtaining Input Data
Selecting an MDS Procedure
Deciding on the Number of Dimensions
Labelling Dimensions and Interpreting the Configuration
Assessing Validity and Reliability

Figure 4.12: Steps in Multi-Dimensional Scaling

1) **Formulating the Problem:** The main objective behind using the results obtained from MDS should be mentioned by the researcher during the problem formulation, and alongwith this, it is also required to have a brand selection or other stimuli selection, which are to be included in the analysis. The nature of the resulting configurations and dimensions is influenced by the number of chosen brands or stimulus, and certain included brands.

2) **Obtaining Input Data:** There can be a relation between the perceptions or preferences and the input data collected from the respondents.

   i) **Perception Data**

      a) **Direct Approaches:** In this type of approach, the respondents are asked to identify the various types of similarities and dissimilarities between the different brands or stimuli in order to collect perception data. Their judgment depends upon their own criteria and principles. Almost all combination of brands or stimuli are to be rated by the respondents in terms of similarities on a Likert scale.

      b) **Derived Approaches:** In case of derived approach of perception data collection, the various brands or stimuli are rated by the respondents in the identified attributes with the help of semantic differential or Likert Scales and are termed as attribute-based approach.

   ii) **Preference Data:** This type of data is collected when the respondents create a particular order of the chosen stimuli or brands depending upon their attitude and preferences. Preference ranking can be seen as one of the most popular methods of data collection. The ranking of the brands from the most preferred to least is done by the respondents.

3) **Selecting an MDS Procedure:** The selection of a particular MDS procedure is based upon whether there is a requirement of both types of data for analysis or whether preference or perception data are being scaled. It is also determined on the basis of nature of input data. Usually, two types of procedures are selected:

   i) **Non-Metric MDS Procedures:** Under non-metric MDS procedures, it is presumed that the input data is ordinal in nature and will provide a metric result. The interval scaling will be used in the case of distances in the resulting spatial map. With these procedures, a spatial map will be obtained in a certain dimensionality having a rank of estimated distances between brands or stimuli.

ii) **Metric MDS Procedures:** Opposite to non-metric MDS procedures, the data assumed in metric MDS procedures is metric in nature. Thus, a stronger relationship between the input and output data is established and the metric (interval or ratio) traits of the data will be maintained due to metric output. However, same kinds of results are obtained in both the metric and non-metric methods.

4) **Deciding the Number of Dimensions:** Having a spatial map is considered as the main goal of MDS. This map should match the input data even in the smallest dimension. The computation of spatial maps is done in such a manner that it improves with the increasing number of dimensions and thus results in a compromise.

With the help of stress measures, the fit of an MDS solution is determined. Stress is a depiction of lack-of-fit method which indicates the poor fits in case of higher values. The number of dimensions can be determined with the help of below mentioned guidelines:

i) **Prior Knowledge:** A certain number of dimensions can be suggested by previous theories or past researches.

ii) **Interpretability of the Spatial Map:** When the maps or the configurations are obtained in more than three dimensions, it will create problems in interpretation.

iii) **Elbow Criterion:** There must be an examination of stress *versus* dimensionality plot. A convex pattern will be formed by the points in this plot. A suitable number of dimensions are represented by the point at which an elbow or a sharp bend is observed. The fit cannot be improved if the number of dimensions is increased beyond this point.

iv) **Ease of Use:** Working with the two-dimensional maps or configurations is quite easier in comparison to multi-dimensional maps.

v) **Statistical Approaches:** For determination of dimensionality, various statistical approaches are available for sophisticated users.

5) **Labelling Dimensions and Interpreting Configuration:** When the spatial map is formulated, there must be proper labelling of the dimensions and various configurations should be interpreted. Subjective judgement will be required from the researcher while labelling the dimensions. For this purpose, the below mentioned guidelines can be followed:

i) The ratings of the brands on researcher supplied traits can be collected despite having the direct similarities. The fitting of these attribute vectors is possible in the spatial map with the help of some statistical methods like regression. Labelling of the axes can be done for attributes with which they are aligned in the most beneficial way.

ii) The method used in the evaluation has to be described by the respondents, once the direct similarities or preference data is provided. In order to label the various dimensions, these methods can be subjectively related to the spatial map.

iii) If feasible, spatial maps could be shown to the respondents so that they can label the various dimensions by monitoring the configurations.

iv) For the interpretations of the subjective dimensions of the spatial maps, objective brands' attributes (such as miler per gallon or horsepower for automobiles) can be employed.

6) **Assessing Validity and Reliability:** The input data and the corresponding MDS solutions will be subjected to substantial random variability. Thus, it is quite important to evaluate the reliability and validity of the MDS solutions.

4.4.7.3. How to Interpret Output

For finding the MDS solution, different types of algorithms are available at present. An iterative process is used in almost all MDS methods. Beginning with initial configurations of objects, minimum number of dimensions is chosen in these methods for reproducing the proximity which is observed in the objects of the input data. This is usually done through systematic rotation and introduction of new dimensions in the output. In order to decide the number of dimensions which have to be derived in the MDS solution, there is no such statistical formula available. In order to avoid the further generation of dimensions, various algorithms are used in various processes.

Interpretation of MDS Results

An analyst has to face a lot of challenges while naming the obtained dimensions of a MDS output. Th configuration can be plotted easily and just by doing the visual inspection of the graph, it is possible label the various dimensions. For this purpose, one has to consider various information related to the trai of the objects. There will be a superimposition of the perceptual map and the scores of the certain attribu in the attribute-based models which are obtained from the MDS output for having a better understanding different axes.

In brief, the below stated issues are considered by the MDS analysts while taking the decisions in marketin research:

1) Prepare the stimuli (i.e., explain the various objects which have to be analysed).
2) Conclude how to obtain the various similarities judgements (i.e., select an attribute/non-attribute frame judgement process).
3) Take decisions regarding compilation of the data obtained, if yes, then in what manner?
4) Select the algorithm and develop the perceptual map.
5) Name the resultant dimensions.

4.4.7.4. Applications of Multi-Dimensional Scaling

MDS is helpful in visually representing the perceptions and preferences of the customers on a spatial map. It i closely associated with the brand positioning.

While researching on product planning, a special emphasis is made upon analysing the market structure creating master configuration of product perceptions, roles of individual differences, representing custome preferences, market segmentation issues and use of asymmetric MDS for studying market structure.

1) **Target Market Selection:** A combination of methods are used in Multidimensional Scaling which can be used to express the manner in which different offerings related to the product or service classes are viewed by the consumers.

   Perceptual mapping is another name of these methods as its main objective is to differentiate the perception of the consumer spatially with reference to their preferences for or the similarities which exists among various objects (such as companies, services and products) with reference to the distances in the multidimensional space. With the help of these techniques, the researchers can determine the various special attributes related to the products/services.

   Having a clear perception about the real context of a product is quite important for the consumer. With this, it is possible to find the correlation between the perceptions consumers and the company's management. Some very vital strategic directions are also facilitated by multidimensional scaling in the situations where the company finds that the target market has a certain competitor who is closely associated with its own offerings.

   Thus, with the help of advertisements, the firm can focus on educating the target market regarding the significant attributes of the products and services. **For example,** if a competitor has more environment friendly image, some kind of advertising campaign can be initiated by the firm to communicate the customers that they are also performing many environment friendly activities.

2) **Positioning:** The appropriateness of any advertisement or tagline can be evaluated with the help of perceptual mapping on the basis of the target market segment. Apart from this, the most suitable advertisement or tagline for a certain brand name can also be identified with the help of mapping technique.

   The main objective of MDS is that consumer judgement about their preference or similarities for a certain brand or store can be transformed into various distances which are depicted in multidimensional space. The comparative positioning of different objects can be represented by resulting perceptual maps. For positioning of products and brands, this multivariate analysis is quite commonly used. Further, with the help of this concept, the positioning of the products or brands in the market can be represented in the form of graph.

3) **Other Applications of Multi-Dimensional Scaling:** The various applications of multi-dimensional scaling are as follows:
   i) It helps in seeking white space gaps or opportunities for recognising new products.
   ii) It helps in determining the advertisement effectiveness by evaluating the position of the brand before and after the ad campaign.
   iii) It helps in determination of perceptions and attitudes of consumer.
   iv) It helps in identifying the brand attributes and the attributes of competitors.

4.4.8. Conjoint Analysis

The relative importance consumers attach to the relevant attributes and the utilities which are attached with the levels of attributes are determined by the conjoint analysis. After evaluating the consumers' brands or brands profile, this information is derived which consist of attributes and their levels. The stimuli which consist combinations of attribute levels is presented by the respondents. This is asked by the respondents to evaluate these stimuli in terms of their desirability. Values are assigned to the levels of each attributes in the procedure of conjoint analysis. This is done due to the resulting values or utilities which are attached with the stimuli matched. It is assumed that any set of stimuli such as products, brands, or stores, is evaluated as a bundle of attributes.

Like multi-dimensional scaling, conjoint analysis also depends on the respondents' subjective evaluations. Conjoint analysis is search for the development of part-worth utility functions which describe the utility consumers attach to the levels of each attribute. The two techniques are complementary.

4.4.8.1. Objectives of Conjoint Analysis

1) **Determine Relative Importance of Attributes:** Relative importance of attributes is determined in the consumer choice process. Relative importance weights for all the attributes which are used to construct the stimuli for evaluating task consist of the standard output from conjoint analysis. The importance of attributes which influence the consumer choice is indicated by the relative importance weights.

2) **Estimating Market Share of Brands:** Market share of brands are estimated which differ in attribute levels. For determining the share of choices and market share of different brands, the utilities which are derived from the conjoint analysis can be used.

3) **Determining Composition of Brand:** Determine the composition of the various preferred brand. The variation exist in brand features in terms of attribute levels and the related utilities determined. The composition of the most preferred brand is indicated by the brand features that yield the highest utility.

4) **Segmenting Market:** Similarity of preferences for attribute levels is the basis of the market segmentation. Clustering respondents to arrive at homogeneous preference segments is based on the part-worth functions which are derived for the attributes.

4.4.8.2. Selection of Conjoint Analysis Procedure

Following formula is used to represent the conjoint analysis model:

$$U(X) = \sum_{i=1}^{m} \sum_{j=1}^{k_i} \alpha_{ij} x_{ij}$$

Where,

$U(X)$ = Overall utility of an alternative

α_{ij} = the part-worth contribution or utility associated with the j^{th} level ($j, j = 1,2,\ldots k_i$) of the i^{th} attribute ($i, i = 1,2,\ldots m$)

k_i = number of levels of attribute i

m = number of attributes

$x_{ij} = 1$ if the j^{th} level of the i^{th} attribute is present

$= 0$ otherwise

The importance of an attribute, I_i, is defined in terms of the range of the part-worths, α_{ij}, across the levels of that attribute:

$$I_j = \{\max(\alpha_{ij}) - \min(\alpha_{ij})\}, \text{ for each } i$$

The attribute's importance is normalised to ascertain its importance relative to other attributes, W_i:

$$W_i = \frac{I_i}{\sum_{i=1}^{m} I_i}$$

So that, $\sum_{i=1}^{m} W_i = 1$

There are different procedures for approximate assessment of basic conjoint analysis model. Among these dummy variable regression is the simplest one but popularity of this procedure is decreasing day by day. Under this procedure, the predictor variables consist of dummy variables which are meant for the attribute levels. **For example,** attribute k_i levels are coded as $k_i - 1$ for dummy variables. The dependent variable is formed by interval scales if metric data are obtained. On the other hand, when the metric data is not available paired comparisons scales are used to rank either 0 or 1. LINMAP, MONANOVA and LOGIT model are the other procedures meant for non-metric data.

A decision is to be taken if the analysis is to be conducted at individual or group level. For carrying out analysis at individual level, each respondent is required to be analysed separately.

For the purpose of carrying out group level analysis certain process is needed to be undertaken to establish categories of the groups. Most common way is to make the categories based on the utility or value of individual parts. After this, clustering of the respondents is done based upon level of similarity of their part-value.

Now, a separate group analysis is done for each cluster. There is also a need to specify the suitable model for the estimation of relevant parameters.

4.4.8.3. Steps in Conjoint Analysis

The steps involved in conjoint analysis are listed in **Figure 4.13**. In order to formulate the problem, the important characteristics are needed to be identified. These characteristics and levels are further used in stimuli construction which is useful for conjoint analysis task.

The data is collected and analysed concerning the stimuli. Then the interpretation is done alongwith the assessment of the reliability and validity.

1) **Formulating Problem:** The attributes and attribute levels to be used in building the stimuli need to be identified first while formulating the conjoint analysis problem. Here, attribute levels are referred to the values anticipated by the attributes. From the management view point, these attributes and their levels must be workable. **For example,** simply telling the manager that the customers prefer luxurious cars over traditional models is not appropriate, instead the attributes of the luxurious and traditional cars need to be defined so that the manager can exercise control over these attributes. In order to identify these attributes, discussion can be conducted with the management team and experts. Other sources for identifying these attributes can be secondary data analysis, pilot surveys and qualitative research.

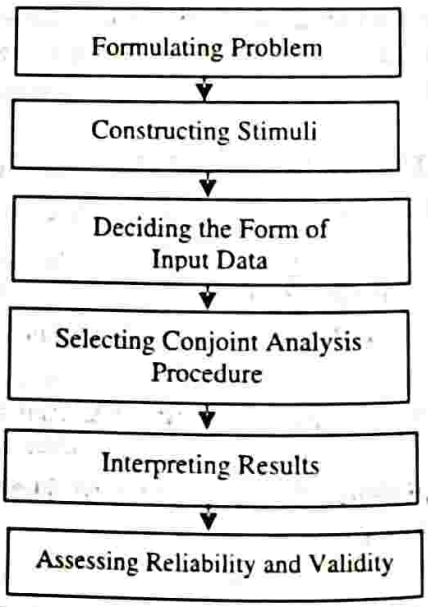


Figure 4.13: Steps in Conjoint Analysis

After successfully identifying the attributes, levels of these attributes are also required to be selected. These attribute levels will further influence the customer evaluations.

2) **Stimuli Constructing:** In order to construct conjoint analysis stimuli, following two approaches are used:
   i) **Pair-Wise Approach:** This approach is also known as two-factor evaluation. Here, at a time two different attributes are evaluated by the respondents. This process continues until all the attributes are evaluated.
   ii) **Full-Profile Approach:** Another name for full-profile approach is multiple-factor evaluations. Here, for all the attributes, complete profiles of brands are constructed and each profile is described based on a separate index card.

In pair-wise approach the respondents find it easier to give their opinion. However, they have to devote more time and effort in evaluation in case of pair-wise approach as compared to full profile approach. Further the results may not be so reliable due to the fact that only two attributes are considered at a time. Although both methods provide substantial utility, still full profile is generally preferred.

3) **Deciding the Form of Input Data:** Similar to MDS, input data in conjoint analysis can be metric or non-metric:
   i) **Metric Data:** In case of metric data, independent judgements are generally made. Here, the respondents give ratings instead of rankings.
   ii) **Non-Metric Data:** In case of non-metric data, the respondents are needed to give the evaluation based on order ranking.

4) **Selecting Conjoint Analysis Procedure:** (Details Given Above in Separate Heading.)

5) **Interpreting Results:** For understanding the results, it is advisable to prepare graph for important functional characteristics. Generally pricing is governed by the attributes of the product. The more relatively important the attribute is the more price it will have. The next basis for pricing is attached to product's uniqueness followed by its outer appearance. The respondents who are greatly influenced by price tag are termed as price sensitive.

6) **Assessing Reliability and Validity:** Procedures for establishing reliability and validity of conjoint analysis are as follows:
   i) Appropriate evaluation of the goodness of fit of the estimated model should be conducted. This will help in knowing if the model that is being used is suitable or not. Suppose if dummy variable regression is being employed, then here, the value of R^2 obtained after evaluation will be able to predict the extent upto which this model will fit the data.
   ii) By obtaining a few duplicated judgments later in data collection, test-retest reliability can be measured. In this procedure the respondents are requested to repeat certain selected tests to confirm the reliability of stimulants. These values obtained are correlated with each other for evaluating the test-retest reliability.
   iii) Validation stimuli can be evaluated and predicted by estimating the part-worth functions. The estimations thus obtained can be verified by correlating it with the estimations given by the respondents to arrive at internal validity.
   iv) After group level analysis, the estimation sample can get divided in various ways and on each sub-sample thus obtained, conjoint analysis can be conducted. The results thus obtained are required to be compared with results of other subgroups belonging to other subgroup levels. This will predict the stability of conjoint analysis solution.

4.4.8.4. Applications of Conjoint Analysis

Following are the applications of the conjoint analysis:

1) **Optimum Product Design:** The addition of attribute levels of all products makes it possible to provide a comparative chart with part worth of its utility. This also enables to estimate the demand of different products out of different group sets of products available in the market. The demand level also enables to estimate profit, production and marketing costs involved. Since volume of operations undertaken in manufacturing product and the relevant features of the products are known, the calculation of total cost becomes easier. With the help of such calculations, the products can be easily selected either based on profit

motive or other objectives set by the management. Buying rates of customers is also considered in this analysis. The availability of data base part worth utility also enables to predict the effects of slight changes in the attributes of the product. This is a very important feature to formulate marketing strategies for a manager to compete with rivals.

2) **Market Segmentation:** Conjoint Analysis is undertaken at the individual customer level, and therefore, individual customer's identity can be reserved throughout such analysis. This makes it possible to predict the behaviour of certain customers towards a particular product and segment the customers accordingly. For the planned product position, appropriate customer segment can be identified using conjoint analysis which will help in attracting maximum customers. It also identifies the area of competitors' market which can be served and makes an illegal hunt to snatch market share from the competitor. An analysis is also possible to locate the weakest section of marketing in business of an entrepreneur. At times a launch of additional product in the market looks to be very attractive. The exercise of launch of additional product will require use of existing components from existing products and making minor modifications without need of material or production cost. However, this can prove risky and lead to cannibalisation of old products by launch of new modified products. Conjoint analysis also helps in managing the negative effects of cannibalisation and providing maximum profit to the businessman or marketer.

3) **SWOT Analysis:** This analysis offers the entrepreneur to conduct an extensive research on strengths, weaknesses, opportunities as well as threats about the product to be launched and existing competing products in the market. Due to these characteristics this is also nick named as SWOT in short form.

4) **Estimating Customer Level Brand Equity:** This analysis also provides a feedback from the customers end on the product of the company as well as the optimum price tag to be attached to the product by the company.

   Thus providing the value of the brand equity in the eyes of customers. Even it goes up to the extent of revealing the number of "Loyal", "Acceptors" and "Switchers" in the market for the product to be launched which enables for accurate measurement of brand equity of the product.

4.5. APPLICATION OF STATISTICAL SOFTWARE FOR DATA ANALYSIS

4.5.1. Introduction

Various methods of data analysis have existed throughout history. Earlier, data analysis was done manually (pen and paper) but with the development of technology, simple as well as scientific calculators have been developed which made analysis of data very easy. Software that has now made the process of presentation and calculation of data comparatively easy is called statistical software. Researchers can avoid the mathematical errors that occur regularly and obtain correct results with the help of this software if the data entered is correct.

Statistical software also helps many business managers, professionals, scientists and researchers to predict the future with precision. According to one's needs, people can make use of several freeware or proprietary based statistical software designed for different types of analysis. **For example**, SAS, SPSS, EVIEW, EPI-INFO, STATA, etc.

4.5.2. SPSS

SPSS is an abbreviation for "Statistical Package for the Social Sciences". It is used for quick analysis of high volume of social science data, collected from different methods of research and developed by **Norman H. Nie, C. Hadlai** and **Dale H in 1968.**

SPSS is a computer program that is basically used for survey, authoring & deployment, data mining, text analytics, statistical analysis, and collaboration.

SPSS is a statistical, graphical and multipurpose data storage system.

Fundamentally, SPSS is used for data analysis of people attitudes, behaviours, etc. It is primarily used in various fields (such as Political Science, Communication, Sociology, Social Work, Psychology, etc.) for their analysis and research.

SPSS is good statistical package used by researchers to perform quantitative research in social science. It is easy to use and handle.

Following functions are covered by the SPSS software package:

1) It summarises the data (e.g., computing means and standard deviations),
2) Determine, whether there are significant differences between groups (e.g., t-tests, analysis of variance) or not,
3) Inspect the relationships among variables (e.g., correlation, multiple regressions) and graph results (e.g., bar charts, line graphs).

Use of SPSS in Data Analysis

Some common applications of statistical software include analysis of data distribution, descriptive statistics, test of association, as well as dependent and interdependent multi-variate tests. Following are some other applications of software in research:

1) **Data Collection and Organisation:** It has similar screen as excel. So process of collection and data organisation can be easily done by the researcher. He can also label a variable and save the data file in the computer.

2) **Statistical Tests:** It is very useful when researcher executes the statistical test. It contains all the statistical tests. Researcher can also create and modify the mathematical equations. After performing a statistical test, the output will be shown in the 'output file'. Data transformation is also possible in SPSS.

3) **Simplifying Research Programming:** For the simplification of research program, SPSS keeps all the constraints in internal file structure, data types, data process and matching files. In SPSS database, all the data are saved in table format where rows of table represent the cases, such as individual and column represent measurement, such as age. Simplification is easy because only two data types (text and numeric) are used.

4) **Research Data Management (RDM):** It provides comprehensive and flexible statistical analysis and data management solution to researchers. Researcher can take the data from any kind of file and can also produce that data in the following forms:
   i) Tabulated Reports,
   ii) Charts,
   iii) Plots of Distributions,
   iv) Trends, etc.

5) **Extracting Data Input and Output:** SPSS can read and write the data from the ASCII text file, spreadsheet, and also from database. SPSS uses the SQL (Structured Query Language) and ODBC (Open Database Connectivity) to perform read and write operations in an external database.

6) **Handling the Complexity of Research:** SPSS converts the information into knowledge. It means that the information which is collected by the researcher for decision-making can be used as knowledge in the future, to take the decisions.

7) **Research Quality Control:** SPSS provides standardised quality control and improvement solution which can be easily validated this validation process covers entire range of manufacturing statistics, which includes:
   i) Descriptive Statistics and Graphics,
   ii) QC(Quality Control) Charting,
   iii) Capability Analysis for Normal and Non-Normal Distributions and
   iv) Design of Experiment (DOE), etc.

8) **Compliance and Validation:** For the validation purpose, SPSS provides some core pre-validation platform. This platform is associated with the secure administration and configuration control. It provides the audit trails, when system configuration changes, data is manipulated and other data modules are integrated.

9) **Miscellaneous Applications:** SPSS software package performs statistical analysis from basic descriptive statistics (e.g., average and prevalence) to advanced inferential statistical analysis (e.g., regression model, analysis of variance, factor analysis etc.). SPSS contains many tools to manipulate data, which includes:
   i) Functions for Recording Data,
   ii) Macros Programming on Visual Basic Editor,
   iii) Merging Data,
   iv) Aggregating Complex Data Sets, etc.

   SPSS offers specialise techniques that are used in design, development and implementation of corporate analytical and data mining solutions connected with existing data acquisition and storage of system.

4.5.3. SAS

Due to its programmability and power, Statistical Analysis Software or SAS is liked by many users. It is considered as one of the difficult software to be learned. SAS can be used when one knows how to write SAS programs that could manipulate and analyse the data. However, finding and correcting the errors in SAS is difficult. Compared to learning other statistical packages such as STATA or SPSS using simple commands, it takes an even longer time to understand and learn data management in SAS. SAS can simultaneously work on several data files at a time. It can also handle data files with a large number of variables. However, the number of records that it can hold is restricted to the hard disk's size.

Use of SAS in Data Analysis

SAS can perform the data analysis of specialised departments as well as the whole enterprise. It has a complete set of tools that can help to perform the data analysis for the whole organisation. There are several uses of SAS such as:

1) **Analysis of Variance:** Unbalanced and balanced designs, linear and non-linear mixed models, repeated measurements and multivariate analysis of variance.

2) **Mixed Models:** It includes Generalise linear mixed models, Non-linear mixed models, and Linear mixed models.

3) **Regression:** It includes Diagnostic measures, Loess regression, robust regression, Quadratic response surface models and non-linear regression, Partial least squares, and Least squares regression with model selection methods including stepwise regression.

4) **Categorical Data Analysis:** It includes Measures of association and contingency tables, Log-linear models and logistic regression, generalised linear models, Exact methods, Weighed least squares regression, Generalised estimating equations, and Bioassay analysis.

5) **Bayesian Analysis:** It includes:
   i) Bayesian modelling and inference for generalised linear models, piece-wise exponential models, Cox regression models and accelerated life failure models.
   ii) General procedure fitting Bayesian models with likelihood functions and arbitrary priors.

6) **Multivariate Analysis:** It includes Structural equations, Principal components, Factor analysis, Canonical correlation and discriminate analysis, and Path analysis.

7) **Survival Analysis:** It includes accelerated time failure models, proportional hazards models and comparison of survival distributions.

8) **Psychometric Analysis:** It includes Correspondence analysis, Conjoint analysis and variable transformations and Multidimensional scaling.

9) **Cluster Analysis:** It includes:
   i) Disjoint clustering of large data sets,
   ii) Hierarchical clustering of distance or multivariate data, and
   iii) Non-parametric clustering with hypothesis testing for various clusters.

10) **Non-Parametric Analysis:** It includes:
   i) Non-parametric analysis of variance. Computing exact probabilities for several non-parametric statistics.
   ii) Friedman, Kruskal-Wallis and Wilcoxon-Mann-Whitney tests.
   iii) Several other rank tests for unbalanced or balanced two-way or one-way designs.

11) **Survey Data Analysis:** It includes Frequency table analysis, Sample selection, T-tests and descriptive statistics, and Linear and logistic regression.

12) **Multiple Imputation for Missing Values:** It includes:
   i) Combining outcomes for statistically valid conclusions,
   ii) MCMC method for random missing patterns, and
   iii) Regression and propensity scoring for monotone missing patterns.

13) **Study Planning:** Suitable interface is offered by power and sample size application in order to compute confidence intervals, rank tests for survival analysis, test of proportions, linear models, sample size and characteristics of power for t-tests.

4.5.4. STATA

STATA is made up of two words - statistics and data. It is a very powerful statistical software package that provides a varied range of latest statistical techniques, smart data management facilities and an outstanding system for creating graphs of publication quality. Computers running on Mac, Windows and Unix support STATA. STATA/IC (Intercooled STATA) is the standard version of STATA which can handle variables as much as 2,047 in number whereas STATA/SE is the special edition which can handle variables as much as 32,766 in number. This special version can also handle large matrices and long string variables. STATA/MP is another version for multiprocessor computers that performs the same work in a faster way.

Most of the common statistical analyses such as regression, logistic regression, analysis of variance, survival analysis, time series analysis, multivariate analysis and factor analysis are performed by STATA.

Use of STATA in Data Analysis

STATA can be used in the following ways:

1) **Time Series Analysis:** The statistical tasks related to time series data is performed by time series analysis, such as common factors, autocorrelations, autoregressive conditional hetero-skedasticity, co-integration, unit roots etc. The use of STATA in time series analysis can be in the form of filtering, graphing and fitting sophisticated multivariate models.

2) **Panel Data:** Panel data examines the ever changing features of time in panels, the manner in which the outcomes of interest alter with time and the association existing throughout different panels. Panel data fits nonlinear or linear models for ordinal, binary, survival, count, or censored outcomes with random effects, fixed effects or population averages estimators.

3) **Bayesian Analysis:** With the help of extensive graphical tools, one can visually check the convergence. Also computing of functions and credible intervals for model parameters as well posterior mean estimates can be done. Along with this, both model and interval based testing of hypothesis can be performed.

4.6. HYPOTHESIS TESTING

4.6.1. Introduction

Hypothesis testing plays an important role in the application of statistics to real-life problems. Hypothesis testing helps the researchers to make the decisions by using sampled data of unknown distribution of a population and its parameters.

For example, consider a manufacturing company which makes the geyser and the average life of the geyser is 1000 hour when manufactured through old process and the average life is 1500 hours when the geyser is manufactured by the new process. So in this case we can make three hypothesis:

1) New process is better than old process.
2) Old process is better than new process.
3) There is no difference between both the processes.

4.6.2. Hypothesis Decision Table

These tables are the combination of rows and columns and every row corresponds to a single rule. Columns in the table explain the action and condition for the rules. When every condition is valid then the action of a given rule is performed. **Table 4.3** shows a hypothesis decision table.

Table 4.3: Hypothesis Decision Table

Decision	Null Hypothesis	
Accept H_0	Correct Decision	Type II Error
Reject H_0	Type I Error	Correct Decision

4.6.3. Element of Hypothesis Testing

Following are the two basic elements of hypothesis testing.

1) **Test Statistic:** It is determined from the sample. To test the statistic researchers assume that the hypothesis of population parameter is true and then compare the actual value with the hypothetical value of the parameter. If the difference is small, then the hypothesis is accepted, else rejected. A statistic on which the decision can be based, whether to accept or reject a hypothesis, is called **Test Statistic (T.S.)**. Following are the examples of test statistic:

$$\text{T.S. } Z = \frac{(\bar{X}_1 - \bar{X}_2)}{\sqrt{\left(\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}\right)}} \qquad \text{(for Z-test, for two Samples)}$$

In case of one sample, test statistic (T.S.) is given as below:

$$\text{T.S. } Z = \frac{\bar{X} - \mu}{\frac{\sigma}{\sqrt{n}}} \quad \text{where, } \frac{\sigma}{\sqrt{n}}$$

2) **Acceptance Region and Rejection Region:** All possible values which a test-statistic may assume can be divided into two mutually exclusive groups: one group consisting of values which appear to be consistent with the null hypothesis and the other having values which are unlikely to occur if H_o is true. The first group is called the acceptance region and the second set of values is known as the rejection region for a test.

3) **Rejection Region:** The rejection region is a subset of the sample space and is associated with the statistics test. If the observed sample falls only within this set, then the researcher can reject the null hypothesis and choose its alternative.

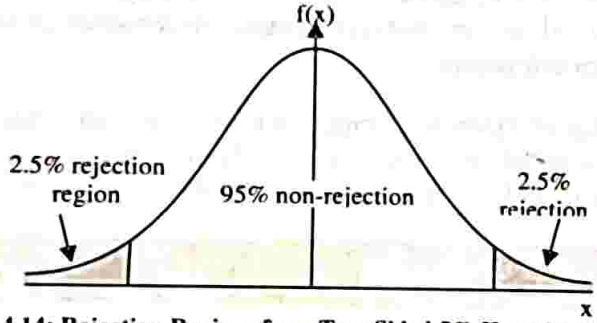


Figure 4.14: Rejection Regions for a Two-Sided 5% Hypothesis Test

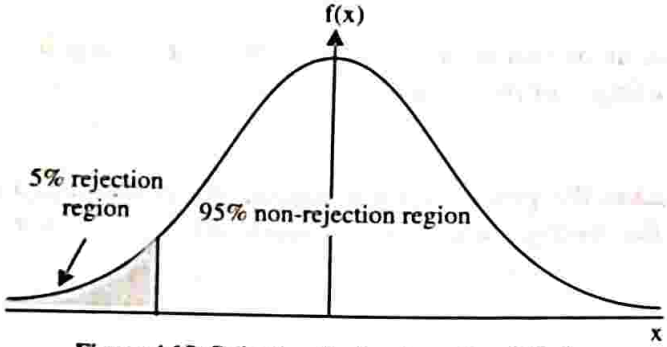


Figure 4.15: Rejection Region for a One-Sided Hypothesis Test of the Form – H_0: $\beta = \beta^*$, H_1: $\beta < \beta^*$

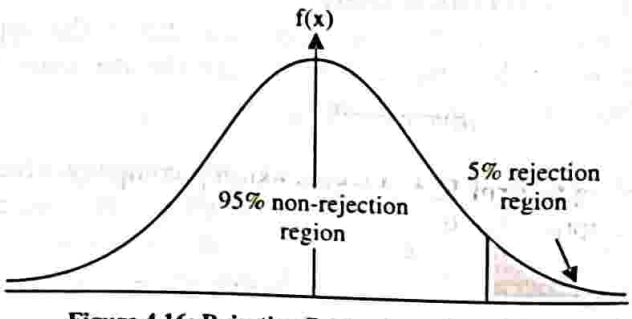


Figure 4.16: Rejection Region for a One-Sided Hypothesis Test of the Form – H_0: $\beta = \beta^*$, H_1: $\beta > \beta^*$

Example 6: 50 smokers were questioned about the number of hours they sleep each day. One wants to test the hypothesis that the smokers need less sleep than the general public which needs an average of 7.7 hours of sleep. The steps below are followed:

i) Compute a rejection region for a significance level of 0.05.
ii) If the sample mean is 7.5 and the population standard deviation is 0.5, what can be concluded?

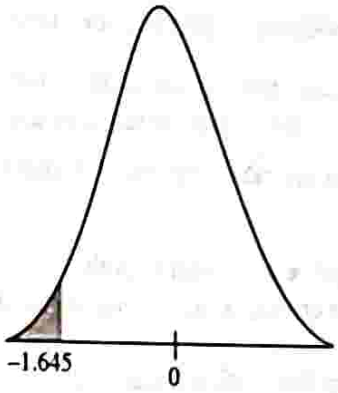
Solution: The null and alternative hypotheses are as follows:

$H_0: \mu = 7.7$
$H_1: \mu < 7.7$

This is a left-tailed test. The z-score that corresponds to 0.05 is –1.645. The critical region is the area that lies to the left of –1.645. If the z-value is less than –1.645 there one will reject the null hypothesis and accept the alternative hypothesis. If it is greater than –1.645, then one will fail to reject the null hypothesis and say that the test was not statistically significant.

$$Z = \frac{7.5 - 7.7}{0.5/\sqrt{50}} = -2.83$$

Since –2.83 are to the left of –1.645, it is in the critical region. Hence the null hypothesis is rejected and the alternative hypothesis is accepted. One can conclude that smokers need less sleep.



4.6.4. Steps in Testing Hypothesis

Step 1) Set up a Hypothesis: To set up the hypothesis, first set the null hypothesis (denoted by H_0). Null hypothesis is tested for the possible rejection under the assumption that it is true. It is expressed in the form of equation.

Null hypothesis is given as follows:

$H_0: \mu = \mu_0$

Where,
μ = Population Means, and
μ_0 = Hypothesized Value of the Population Mean.

For example, to test whether a population mean is equal to 140, the null hypothesis can be set as "population mean is equal to 140".

$H_0: \mu = 140$

Now set the alternative hypothesis which is rationally opposite to the null hypothesis and is denoted by H_1.

According to Prof R.A. Fisher: "Null hypothesis is the hypothesis-which is tested for possible rejection under the assumption that it is true".

Note: When null hypothesis is true, then the alternative hypothesis must be false and *vice versa*.

Alternative hypothesis is given as:

$H_1: \mu \neq \mu_0$

Therefore, $H_1: \mu < \mu_0$
$H_0: \mu > \mu_0$

For the above example, the alternative hypothesis can be set as "population mean is not equal to 140".
So, $H_1: \mu \neq 140$

This gives the two other alternative hypotheses:
$H_1: \mu < 140$, Indicates i.e., the population mean is less than 140 and

$H_1: \mu > 140$; Indicates i.e., the population mean is greater than 140.

Step 2) Set up a Suitable Significance Level: Significance level is related to the null hypothesis and denoted by α. The size of the rejection or critical region is also known as the level of significance. Ensure that the obtained result is free from decision-maker's biasness of choice. For this, the significance level must always be determined before we draw samples.

0.01, 0.05, and 0.10 are the most commonly used levels of significance by researchers.

Step 3) Test Statistic: In this step one can select the suitable statistical test for the analysis. On the basis of the type, number and level of data, statistical test is decided. To select the statistical test, statistics (mean, proportion, etc..) used in the study is also considered to get the good result.

Step 4) Doing Computations: After selecting the statistical test, the researcher tests the performance of different calculations from a random sample of size n. Here researcher also computes the standard error.

Step 5) Making Decision: In this step, researcher takes the decision that the null hypothesis is to be rejected or accepted.

Following conditions are checked to accept and reject a null hypothesis:

i) When the calculated value is less than the critical value then test statistics falls in the acceptance region and null hypothesis is accepted.
ii) When the calculated value is greater than the critical value then test statistics falls in the rejection region and null hypothesis is rejected.

Generally, in the testing of hypothesis 5% level of significance ($\alpha = 0.05$) is used to take the decision.

4.6.5. Importance of the Tests of Hypothesis

1) It is suitable for establishing the focus and direction in a research effort.
2) It helps the researcher in the development of a hypothesis force which shapes the purpose of the research movement.
3) It determines which variables will not be measured in a study and which will be measured.

4.6.6. Limitations of the Tests of Hypothesis

1) The tests should not be used in a mechanical fashion. They should keep in mind that testing is not decision-making itself. The tests are only useful aids for decision-making. Hence "proper interpretation of statistical evidence is important for intelligent decisions."
2) Tests do not explain the reasons as to why the differences exist, say between the means of the two samples. They simply indicate whether the difference is due to fluctuations of sampling or because of other reasons but the tests do not tell us as to which is/are the other reason(s) causing the difference.
3) Results of significant tests are based on probabilities and cannot be expressed with full certainty. When a test shows that a difference is statistically significant, then it simply suggests that the difference is probably not by chance.
4) Statistical inferences based on the significant tests cannot be said to be entirely correct evidences concerning the truth of the hypothesis. This is especially in case of small samples where the probability of drawing erring inferences happens to be generally high. For greater reliability, the size of samples is sufficiently enlarged.

4.7. IMPORTANT TERMS IN HYPOTHESIS TESTING

4.7.1. Errors in Hypothesis Testing

Two types of errors occur in hypothesis testing:

1) Type I Error
2) Type II Error

Following possibilities occur during the hypothesis testing.

1) Test leads to rejection while hypothesis is true. (Type I Error)
2) Test leads to acceptance while hypothesis is false. (Type II Error)
3) Test leads to acceptance and hypothesis is also true. (No Error)
4) Test leads to rejection and hypothesis is false. (No Error)

The first two possibilities lead to errors. If we reject a hypothesis when it should be accepted (possibility 1), then the error is known as type I error. And if we accept a hypothesis when it should be rejected (possibility 2), then the error is known as type II error.

Consider the following table which provide the basic idea of Type I and Type II error.

	Accept H_0	Reject H_0
H_0 is true	No Error	Type I Error
H_0 is false	Type II Error	No Error

Type I Error

If we reject correct hypothesis then it comes under Type I error and denoted by α.

So, α = Probability of Type I Error = Probability of rejecting H_0 when H_0 is true.

When the difference of the two means is zero and test indicates the rejection of the null hypothesis, then it is known as Type I Error.

Type II Error

If we accept the wrong hypothesis then it comes under the Type II error and denoted by β.

So, β = Probability of Type II Error = Probability of accepting H_0 when H_0 is not true (false). When the difference of the two means is not zero and the test indicates the acceptance of the null hypothesis then it is known as Type II Error.

Difference between Type-I and Type-II Error

Type-I error	Type-II error
Rejecting null hypothesis when it is true is type I error.	Accepting null hypothesis when it is false is type II error.
Type I Error is committed when we reject a correct or true hypothesis.	Type II Error is committed when we accept a wrong or incorrect hypothesis
It is denoted by α.	It is denoted by β.

4.7.2. Level of Significance

We check the validity of the null hypothesis (H_0) against the alternative hypothesis (H_1) at a certain level of significance to setup the hypothesis. Researchers generally use the 5% and 1% level of significance in the research.

Factors Affecting the Level of Significance

1) Size of the difference between sample means.
2) Total size of the samples.
3) Variability of measurements within the samples and
4) Direction (either directional or non-directional) of the hypothesis.

Note: A directional hypothesis predicts the direction of the difference between means and difference between proportions etc.

4.7.3. Degree of Freedom

In statistics, the number of elements in the calculation which are able to vary is known as degree of freedom.

For example, consider that if the mean of the data is 30 and that the values are 20, 15, 45, and one value is unknown. To find the mean of a list of data, add all the data and divide it by the total number of values. Now, if the unknown value is x then using the mean formula:

$$=\frac{20+15+45+x}{4}=30$$

So, $x = 40$.

Now take the situation where two values are missing and are denoted by x and y. So using the mean formula we find that

$$\frac{20+15+45+x+y}{5}=30;\quad \frac{80+x+y}{5}=30;\ x+y=70 x=(70-y)$$

It shows that, when we select a value for x, then the value for y is determined. This shows that here the degree of freedom is one. For n samples the degree of freedom will be $(n - 1)$.

For example, for the sample size of 15, the degree of freedom will be 14. For the s × t size contingency table, the degree of freedom will be $((s - 1)(t - 1))$.

Where

s = Number of columns and
t = Number of rows

Now, if the contingency table is of 2×2, then the degree of freedom is $(2 - 1)(2 - 1) = 1$.

4.7.4. One Tailed and Two Tailed Tests

When the population parameter is known in a hypothesis test and it falls to the right or the left of the centre of the sampling distribution, then it is known as one tailed test. This test is used to check the increase and decrease in the parameter. So, it is used to test the null hypothesis.

For example, junior class students will not score significantly greater than higher class students in an IQ test; women are not significantly stronger than men. In every case, the null hypothesis predicts the direction of the expected difference. When hypothesis predicts that one value is dissimilar from another value and does not predict which is higher, then such hypothesis is known as two-tailed (non-directional).

4.7.5. Measuring the Power of Hypothesis Test

The power of a test denotes the capability of the test to make a right decision, i.e., to reject the null hypothesis in case it is false. The power of a test can also be described as the probability of not making a type 2 error. Mathematically it can be expressed as follows:

Power = 1 – p (Type II error) = $1 - \beta$

The maximum power a test can have is 1, the minimum is 0. Ideally we want a test to have high power, close to 1.

A power curve is the result of plotting 1-β for each possible value of the population parameter. Absolute care should be taken not to reject the null hypothesis (α) when it is correct.

4.8. EXERCISE

4.8.1. Short Answer Type Questions

1) Define data processing.
2) What do you mean by coding of data?
3) What are the simple and complex tables?
4) Give the general data tabulation rules.
5) State the objectives of data analysis.
6) Define inferential analysis.
7) Explain qualitative data analysis, with example.
8) When can bivariate analysis be used? Give the examples of bivariate analysis.
9) What is correlation?
10) Explain two – way ANOVA. Give its example.
11) What are the objectives of discriminant analysis?
12) Define cluster analysis model.
13) Define multiple regression.
14) Define MDS.
15) Explain STATA.

4.8.2. Long Answer Type Questions

1) Discuss the data processing operations. Explain significance of data processing.
2) What do you mean by data analysis? Explain it with example. What are the objectives and phases of data analysis?
3) Explain the data analysis techniques in detail. State the difference between qualitative and quantitative data analysis.
4) Define bi-variate analysis with example. Explain its different techniques.
5) State characteristics and assumptions of Analysis of Variance (ANOVA).
6) Discuss the meaning of multivariate analysis. Throw some light upon multivariate statistical techniques.
7) Explain discriminant analysis. Give its steps. Also discuss the applications of discriminant analysis.
8) Enumerate the concept of factor analysis with example. Give the objectives and procedure/steps in factor analysis.
9) Discuss steps in cluster analysis and its areas of application.
10) What do you mean by Multi-dimensional scaling (MDS)? Give the uses and process of conducting MDS.
11) What is conjoint analysis? Illustrate selection of conjoint analysis procedure.
12) Illustrate the applications of statistical software for data analysis.
13) Explain in detail hypothesis testing. What are the elements of hypothesis testing?
14) Highlight the importance and limitations of tests of hypothesis.
15) Write short notes on:
    i) Level of significance
    ii) One tailed and two tailed test
    iii) Degree of freedom
16) Find the coefficient of correlation between price and sales from the following data:

Price (₹)	103	98	85	92	90	84	88	90	93	95
Sales (Units)	500	610	700	630	670	800	800	750	700	680

[Ans: r = 0.85**]**

17) Calculate the coefficient of correlation between the values of X and Y given below:

X	78	98	96	69	59	79	68	61
Y	125	137	156	112	107	136	123	108

[Ans: r = 0.955**]**

18) From the following data obtain the two regression lines:

X	6	2	10	4	8
Y	9	11	5	8	7

[Ans: x + 1.3y = 16.4, y + 0.65x = 11.9**]**

19) From the following data obtain the two regression lines:

X	1	5	3	2	1	1	7	3
Y	6	1	0	0	1	2	1	5

    i) Predict 'y' when x = 10
    ii) Predict 'x' when y = 2.5

[Ans: 0.3x + y = 2.09, x + 0.28y = 3.56, (i) 0.10, (ii) 2.86**]**

UNIT 5

Report Design, Writing and Ethics in Business Research

5.1. RESEARCH REPORT

5.1.1. Introduction

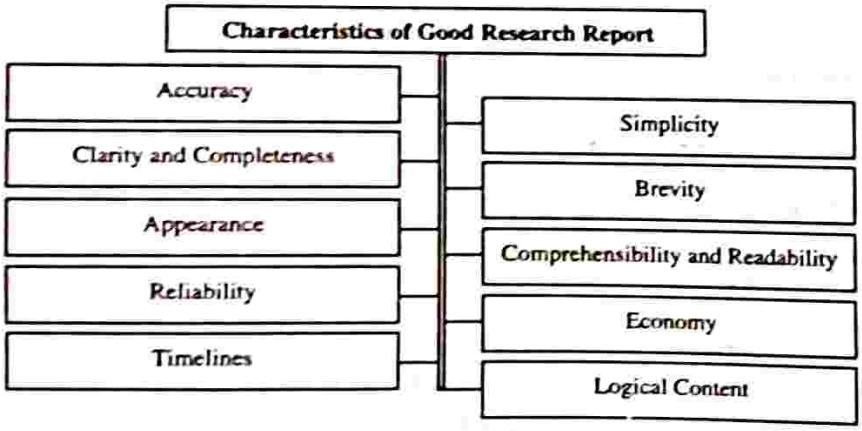
Once the researcher has completed data collection, data processing, developing and testing hypotheses, and interpretation of responses, the next important phase in research is the preparation of project/research report. Research report is very essential for the communication of research findings to its potential users.

According to Lancaster, "A report is a statement of collected and considered facts, so drawn-up as to give a clear and concise information to persons who are not already in possession of the full facts of the subject matter of the report".

When the results of a research are communicated in a written form, it is called "research report". It contains the methodology used for conducting research, the approaches for performing the research, the precautions taken for data collection, the final results or solutions for the research problem, and suggestions for solving related problems. This result can be implemented for effective decision-making by the managers. Generally, the top management is not interested in the procedure or methodology undertaken in the research, but wants to get the final outcome. Hence, research report acts as a presentation that highlights the procedure and methodology adopted by the researcher. Research report presents the complete procedure in a comprehensive way that in turn helps the management in making crucial decisions. Writing a research report follows a particular format, sequence, and writing style. To make a research report more effective, various charts, graphs, diagrams, tables, etc., can be used. By using different representation techniques, researchers are able to convince the audience as well as the management in an effective way.

5.1.2. Characteristics of Good Research Report

A good research report has following characteristics:



1) **Accuracy:** The research report should contain accurate information as in the absence of which the managers might get into trouble. Therefore, the one who prepares the report should try to maximise the accuracy of data presented in the report.

2) **Simplicity:** A research report has practical applicability and is also referred to further researches; therefore the language used in it should be clear, simple and lucid. Also, it should be grammatically correct.

3) **Clarity and Completeness:** The research report should not be incomplete and vague. There should be clarity in it which can be obtained when all the facts are arranged properly. Also, a suitable methodology has to be followed in the report. It should clearly define the purpose, sources, necessary recommendations and findings of the research. It should be free from ambiguity. The report can also be made clear and understandable by dividing it into different sections with separate headings and indications.

4) **Brevity:** Long reports require enough time to be read, and the officials or managers usually lack time. Hence, it is necessary for the reports to present all the important and relevant information in brief. However, clarity and completeness in the reports need to be maintained. Some facts require detailed discussion which should be dealt with.

5) **Appearance:** The appearance of the report should be such that it catches attention. Its format, arrangement, layout and organisation have to be attractive and pleasing to the eyes.

6) **Comprehensibility and Readability:** There should be a sort of convenience in reading and understanding the reports. Use of technical jargons should be avoided alongwith presenting all the relevant facts in appropriate language which is grammatically correct and neat.

7) **Reliability:** Reliability should be maintained in the reports, i.e., it should not only include and present all the relevant facts but those facts should also revolve around the main objective of the report. Exclusion of important facts and inclusion of irrelevant facts will make the report incomplete and confusing which further mislead the readers as they might miss out on some important facts.

8) **Economy:** The preparation of a research report should be cost-effective. Economic methods and standard quality should be adopted in the presentation of the report.

9) **Timelines:** If the readers do not get the report in time, the utility and purpose of it will be lost. Therefore, precaution should be maintained while submitting the reports as any delay will make the report unworthy and as well as out-dated.

10) **Logical Content:** The facts and content presented in the report should be logical and unbiased. Headings and sub-headings which are self-explanatory in nature should be used to indicate unique points. It is also important to note that the facts presented in the reports should be scientifically verified. This is because research reports help in decision making and if facts are incorrect then it might lead to wrong decisions.

5.1.3. Function of Reports

Following functions are performed by reports:

1) **Keeps Permanent Record of the Research:** Reports aid in keeping the permanent records of various past researches so that these can be utilised in future researches.

2) **Awareness:** Reports facilitate awareness regarding new information, standards, interpretations, etc., that are obtained from various researches. This helps in improving the knowledge and can be shared with others.

3) **Formulation of Principles:** A research report allows carrying-out many other small researches systematically that help in formulating certain principle or a concept. Therefore, it is one of the prime concerns for an effective research that it should allow making such principles.

4) **Validate Other's Work:** Research report facilitates learning from the overall process. With the help of footnotes and bibliography, the researchers pay due credit to the other researchers as well. This also validates the work of other researchers.

5.1.4. Types of Reports

Project reports are of following types:

1) **Technical Report:** Technical reports are the reports which contain detailed information about the research problem and its findings. Usually they are studied by specific individuals who are interested in research methodology. Such reports include detailed description of used methods for research design such as universe selection, sample preparation, designing questionnaire, identifying potential data sources, etc. Each

and every step and method or tool is fully described in these reports. While preparing technical reports, it is assumed that the users of such reports have knowledge about research methodology and hence, the language of these reports is technical. One can use technical reports in a situation, where it is required to statistically analyse the collected data. It is also used in performing series of research studies, where the methodology can be repetitively used.

2) **Manuscripts for Journal Articles:** When the report is presented in a specific layout or design for publishing it in an academic or scientific journal, it is known as "manuscripts for journal articles". Journal articles are the concise and complete presentation of a particular research study. While, technical reports present the detailed description of all the activities in a research, journal articles are known for presenting only few critical areas or findings of a study. The readers or audience of journal articles include other researchers, management and executives, strategic analysts and general public, interested in the topic.

   Generally, a manuscript for a journal article is 10 to 30 pages long. Sometimes there is page or word limit for preparing the report. Mainly manuscript for a journal article is submitted online, although sometimes paper copies are also sent by ordinary mail.

3) **Thesis and Dissertations:** A thesis or dissertation is a type of research report, which is typically prepared by a student pursuing a Masters, PhD, or other higher degree. Like other normal research reports, the thesis or dissertation usually describes the design, tools or methods and results of the student's research in detail. A detailed section named literature review is given in such reports, which includes the literature and previous studies on the topic. Firstly the work or research of the student is analysed by a professional researcher or an expert of that particular research field, then the thesis is written under the guidance of a professional supervisor. These dissertations and theses are written in about 120 to 300 pages. Generally, the university or institution decides the length of dissertation or theses. A distinctive feature of a thesis or a dissertation is that it is quite economical, as it requires few printed and bound copies of report. Sometimes electronic copies are required to be submitted along with the hard copy of thesis or dissertations. Compact discs (CDs) are used to generate the electronic copy.

4) **Other Types of Research Reports:** Along with the above mentioned types, there are some other types of research reports also, which are as follows:
   i) **Popular Report:** Popular report is prepared for the use of administrators, executives, or managers. It is simple and attractive in form of report. Clear and concise statements are used with less technical or statistical terms. Data representation is kept very simple through minimal use of graphs and charts. It has a different format than that of a technical by liberally using margins and blank spaces. The style of writing a popular report is journalistic and precise. It is written to facilitate reading rapidly and comprehending quickly.

   ii) **Interim Report:** Interim report is a kind of report which is prepared to show the sponsors, the progress of research work before the final presentation of report. It is prepared when there is a certain time gap between the data collection and presentation. In this scenario, the completed portion of data analysis along with its findings is described in a particular interim report.

   iii) **Summary Report:** This type of report is related to the interest of general public. The findings of such report are helpful for decision making of general users. The language used for preparing summary report is comprehensive and simple. Many graphs or tables are used which make the report easily understandable. The main focus of this report is on objectives, findings, and implications of research issue.

   iv) **Research Abstract:** Research abstract is the short presentation of technical report. All the elements of a particular technical report, such as, research problem, objectives, sampling techniques, etc., are described in research abstract but the description is concise and easy.

5.1.5. Contents of Report

Research reports are written in a specific format. This format is followed to avoid the ambiguity by bringing clarity in the report. The format and writing style of research report varies according to the nature of report. A general format of report has following layout:

1) **Title Page:** This is the first page of a research report, where the title of research is mentioned. When deciding the title, it should be kept in mind that it should be able to explain the objective of research. It

should also be able to get the attention of a reader instantly. Along with the title, the topic of research, the name of researcher, the agency or institution for which it has been prepared, date, and place of submission of report should also be mentioned.

2) **Table of Content:** Table of content enlists various sections of research report along with their corresponding page numbers. It includes various sections and subsections in a sequence of their appearance in the report. It allows the readers to directly go to a certain topic of their interest rather than searching the entire report for it.

3) **List of Tables and Graphs:** The tables and graphs are listed in this page along with their page numbers. This list helps the readers to directly go to certain table or graph of their concern.

4) **Research Proposal and Letter of Authorisation:** The proposal or letter of authorisation shows the objectives, plan, cost and duration of the project. It helps to assess the value of a project. When the proposal is very long, an extract is written in the proposal and the complete proposal is included in annexure. The researcher receives it in the beginning of the research. This letter contains the person who would carry-out the research and the person who is accountable for required resources. This letter is written by the authority who conducts the research project.

5) **Executive Summary:** Executive summary is that part of the research report where the researcher writes a brief summary of a complete research. It gives an overview about the research. Executive summary is an important part of the research report as sometimes managers do not want to read the complete report. Hence, this section introduces them with the objectives and contents of the research report briefly, which helps them in decision-making. Generally, it is of 100 to 175 words, but sometimes, it may extend upto maximum of two pages. Although the executive summary comes before the actual discussion points, but it is written only when the research report is totally compiled so that all the information can be accurately included in it.

   While preparing executive summary, a brief description about some important details should be included in it such as research objectives, sample size and technique, data analysis technique, interpretation of results, findings, conclusions, and scope of research.

6) **Introduction:** The main section of the research report starts with the introduction. This part of the research report describes the purpose, need, and importance of the research project. It introduces the reader with the research problem and related questions. It also highlights the previous related researches. It aware the readers about the problem in broader perspective as well as the related concepts and terms that make familiar with the background. It sometimes includes the definitions about the related terms and concepts that provide additional information.

   The detailing of introduction part depends upon the variety of readers. If the variety is narrow or specific, the introduction part needs not to be too elaborated, which would be just opposite if the readers are more diverse.

7) **Methodology:** This section of the report describes about various methods adopted along with the respective reasons, such as, type of research design, data collection technique, sampling technique, data analysis technique, etc. In this section, a brief description about the complete methodology is given. It is kept in mind that the researcher should avoid using technical jargons. This part should neither be too detailed nor too brief.

   The purpose of writing research methodology is to make the reader familiar with the technicalities of research work. The duration of time in completion of primary steps in research should also be mentioned in this section.

   Research methodology includes the description about following aspects:

   i) **Research Design:** Research design illustrates the type of research design, i.e., exploratory, descriptive, and causal, chosen for the research work and reasons behind the selection.

   ii) **Sampling:** Here, the researcher describes about the nature of population, sample frame, sampling units, sample size, sampling technique, etc., and reasons behind these selections, so that the readers get familiar with the sample taken for research.

iii) **Data Collection:** Here, the researcher needs to mention the details about data collection in the research work. In this section, the researcher is required to discuss whether he has opted primary data sources or secondary sources, and the reasons behind the selection. The researcher also explains all the possible methods with the help of which the data has been collected, i.e., questionnaire, interview, observation, etc. If the questionnaire is used in data collection, then a copy of it should be attached in the annexure of report.

iv) **Fieldwork:** In this section, the complete procedure of fieldwork is discussed. The researcher explains many things about the fieldwork, such as, the number of fieldworkers employed, type of training provided to them, monitoring and controlling of fieldwork, precautions followed during fieldwork, etc.

v) **Data Analysis:** In this section of research methodology, the researcher describes the method adopted for analysing the data, and the suitability of selected method. The complete description is given about the process applied for analysing the data with proper calculations. Various charts and graphs can also be used to explain the data easily. The formulae which are complex should be mentioned in the annexure. Which formula is being used, when, and why, can also be mentioned as footnotes along with the calculations.

vi) **Findings:** In findings, the researcher generalises or interprets the findings from the data analysis. While making generalisations or interpretations, the researcher needs to keep in the mind that findings should be presented in a logical manner, so that it can help in decision-making process. The findings should be made in a way that can answer the research questions. The findings should be represented effectively with the help of various charts, graphs, and diagrams.

vii) **Limitations of Research Project:** Any research project is not completely correct and may have some limitations. In this section of the report, the researcher highlights the potential limitations that influence the reliability of the findings of a research. These limitations can be related to anything such as errors in data collection, sampling, data analysis, etc.

Mentioning these limitations allow the readers to evaluate the research findings as well as scope for further improvement. Researchers should always remember that they should not overstate these limitations, as these may harm the positive effects of the research work.

8) **Conclusions and Recommendations:** Conclusions are made on the basis of approval or disapproval of hypothesis. These either verify or deny the assumptions or hypotheses set for the data analysis. After deriving conclusions, researchers are also required to give recommendations, so that future researches can be done more effectively. These recommendations include various possibilities and decisions that can be applied so that the limitations can be minimised and credibility can be enhanced.

9) **Appendix:** Appendix is the set of all those materials that are supplementary to the main research work, such as, formulae, computations, questionnaire, statistical tables, etc. The readers can refer to supplementary materials while reading a particular section for better understanding.

10) **Bibliography and References:** Bibliography and references are the lists that highlight the books, reports, journals, articles, etc., which have been referred while conducting the research work. These lists mention the name of author, publication, year of publication, volume/edition, etc., in a certain format. When only citations of the entire research work are listed chronologically with the last name of the author, it is called "reference". Bibliography and references validate the research work conducted by the researcher.

5.1.6. Importance of Report Writing

Project report serves many purposes for the organisation and plays a crucial role in management. Preparing a report is important due to following reasons:

1) **Communicates the Information:** Research report can be used as means of communicating facts and information to the top management or executives in the organisation. With the help of reports, ideas, suggestions, and concepts of the organisations are conveyed to their shareholders, customers, general public, top management executives, etc. Communicating information through reports allow the managers to make efficient decisions.

2) **Helps in Evaluation:** Research report helps the managers to re-evaluate their prevailing problem as well as to plan for future efficiently. Research reports also help various departments to co-ordinate and control their activities. Research reports assist general public in finding probable suggestions regarding their problems.

3) **Facilitates Measuring Performance:** Research reports can also help in evaluating performance of a particular department/organisation, town, district, state, or country. It provides relevant and complete information about the performance which in turn helps in finding out the ways for betterment.

4) **Predicts Future Trends:** Research reports contain the facts and figures related to some crucial incidents or occurrence that help in predicting the future occurrences. It can forecast the changing trends of consumer buying, upcoming variation in the market or economy, or need of technical advancement.

5) **Helps in Making Desirable Changes:** Report helps in making desirable changes in a department, organisation, market, or economy, by understanding its consequences and giving valuable suggestions. It identifies the factors responsible for poor performance of a particular plan, policy, scheme, or organisation and provides ideas or solutions to eliminate those factors so that positive changes could be implemented.

5.2. STRUCTURE OF THE RESEARCH REPORT: REPORT FORMAT

5.2.1. Introduction

A research report does not have any specific format; every research report follows a different format. But, the desired clarity and emphasis can be maintained in the reports by following the physical format which includes using different margins, headings, colours and sizes, broad paragraphs, etc. Employing this format will enable to focus on the important facts of the report while clearly explaining the arrangement and relationship of ideas.

The format chosen for report preparation must suit the needs and wants of the users. A standard format of the report is prescribed below which is flexible enough to be employed in most of the situations. However, it is not a strict format that must be followed every time.

1) **Preliminary Section**
   - i) Title Page
   - ii) Acknowledgments (if any)
   - iii) Table of Content and Chapterisation
   - iv) Content of Chapters
   - v) List of Tables and Graphs
   - vi) Executive Summary

2) **Main Body**
   - i) Introduction
   - ii) Literature Review
   - iii) Research Method
   - iv) Interpretation of Data
   - v) Conclusion
   - vi) Suggestions and Recommendation
   - vii) Limitations of the Study

3) **Reference Section**
   - i) End Notes
   - ii) Bibliography
   - iii) Appendix

5.2.2. Title of the Report

The title of the report is the very first page of the research report. This page states the suitable title given to the research report by the researcher. This page also mentions the research topic, the researcher's name, the institution or agency for which it has been prepared and the place and date of its submission. The title should be such that it grabs the attention of the readers and depicts the research objective clearly.

The following points must, however, be kept in mind:

1) The title of the report should be centrally positioned and mentioned halfway down the page.
2) The top left corner of the page should mention the running head.
3) The top right corner of the page must be kept for the page number.

The title page of the report is comparatively easy to prepare, however creating the running head is not that simple. The abbreviated form of the research title which will appear at the top left corner of all the pages of the report in block letters is referred to as running head. It should be simple and appear alongwith the page number. An example of research title alongwith a suitable running head is given below:

1) **Title of the Report:** The Impact of Internet Marketing on Business Management.
2) **Running Head:** Internet Marketing

The research report title should be kept short and concise but needs to include all the essential words which will not only describe the research objective but also provide an adequate level of detail emphasising the research study conducted. Preferably, the title of the research report should be kept in between 12 and 15 words. If a title is lengthy, it can be divided by using a colon. **For example**, The Impact of Internet Marketing on Business Management: A Review from Indian Context.

It is also important to properly phrase the title. If we look at the example provided above, it can be seen that the title incorporates all the essential keywords like performance, agreement, personality, accuracy and rating.Using proper keywords will enable the research to appear in the search results whenever students or researchers are looking for similar researches on the web. However, use of unnecessary phrases and words should be avoided as they serve no purpose. **For example**, research study, reporting results or a study of.

A concise but complete understanding of the research objective should be presented by the title of the report. This page can also include the titles and residential addresses of the receiver and preparer. The title page of confidential reports may also include the names of those people who should be only viewing the report. A title fly page (containing the title of the report only) is included before the title page in most of the formal reports.

5.2.3. Table of Contents and Chapterisation

The table of contents mentions all the headings and sub-headings of different chapters along with their respective page numbers. However, the preface, executive summary, list of figures and tables along with their page numbers (in small Roman numerals) is also usually listed before the main chapters and the indexes and appendices after the main chapters.

More briefly, the table of contents presents a rough idea of all the headings covered in the report. It should neither be too detailed nor too short. The central heading of the page should be the word 'Contents' in block letters whereas the words 'Chapter' and 'Page' (in block letters) should mention the chapter numbers and the corresponding page numbers on the left and right sides of the page respectively. **Table 5.1** illustrates format of 'table of contents' with the help of an example.

A learner can take a look at the entire report with the help of Chapterisation. It includes splitting up the whole content of the report into various chapters and arranging these chapters in an organised manner such that each chapter not only describes a separate aspect of the research but also seems as an extension of the preceding one. A complete examination of the facts collected in all the chapters alongwith their interpretation in order to draw a conclusion is contained in the last chapter. The degree to which the objective of the research has been achieved is specified in the conclusion.

Table 5.1

Table of Contents		
		Page
	Acknowledgement	ii
	List of Tables	vi
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CHAPTER I	**Introduction**	1
CHAPTER II	**Interrelationship of Small Scale Units with Large Scale Units – a Theoretical Analysis**	28
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CHAPTER IV	**Sample Small-Scale Units – A General Appraisal**	95
CHAPTER V	**Extent and Variation of Interrelationship**	112
CHAPTER VI	**Interrelationship *viz-a-viz* Factors**	132
CHAPTER VII	**Summary of Findings and Suggestions for Achieving Higher Degree of Interrelationship**	181
	Conclusion	
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5.2.4. Contents of Chapter

This page contains the details of contents and topics covered under each chapter. This section sometimes states the objective of studying the chapter. On one hand, a table of content briefly outlines the contents of each chapter, whereas a content of chapter details the order of several topics covered in the chapter or the idea flow in it. It outlines the topics within each chapter in a systematic manner. Headings and sub-headings are used to indicate various topics in the chapter which is helpful in learning the subject. The headings present in the table of contents gives information about the chapters whereas a content of chapters enables the readers to derive meaning from them.

Difference between Content of Chapter and Table of Content

Even the most learned authors and editors get confused between content of chapter and table of contents. The headings present in the table of contents help in learning as well as maintaining a balance among different topics, packaging of the textbooks and in sales and marketing.

A content of chapter, on the other hand, describes the thought progression of the author and the logical development of the book. It employs a traditional format that uses Roman letters, Roman or Arabic numerals, etc. The result is a product comprising distinguished sub-topics which are thoroughly included within the larger ones. Although, there are some topics that are in the form of abstract or analysis; in such case, the information is classified in a set format known as taxonomy.

However, the headings which are mentioned in the final chapter in the table of contents categorise the information in a useful and factual manner. These are all actual headings containing definite and genuine information rather than being hollow or mere ideas. There are ideally three or more paragraphs explaining each heading. Therefore, it can be said that the table of contents is concept web or blueprint rather than just a mere classification.

Table 5.2

Contents of Chapter		
		Page
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	Nearness to Large Scale Units	
	Nature of Products of Small-Scale Units	
	Period of Contact between Small-and Large-Scale Units	
	Communal Identity of Entrepreneurs of Small-and	
	Large-Scale Units	
	Personal Interaction with Large-Scale Units through	
	School/College peer Groups	
	Social Relationship of Small Entrepreneurs with the	
	Executives and Entrepreneurs of Large-Scale Units	
	Training Facilities made Available in Large-Scale Units for the Employees of Small-Scale Units	
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	Summary of Findings	
	Suggestions for Achieving Higher Degree of Interrelationship	
	Conclusion	
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5.2.5. Executive Summary

An executive summary or a management summary can be defined as the small document which represents the summarisation of a bigger report, a group of related reports or a proposal. It is written in such a way that it gives a quick view of the entire content in a short description without reading the complete report. It briefly describes the problem statement, the information gathered, the analysis performed and the final conclusion. At times, the managers get benefitted by the executive summary as it assists in making important decisions.

Sometimes, the top-level managers and general audience do not get enough time to read the complete report. Executive summary includes the essential and significant information of a bigger report. Therefore, while writing an executive summary, the researcher should try to express more and more information in fewer words. This should not only highlight the topics to be covered in the report, but also include a brief description. Mostly, an executive summary is placed at the beginning of the report, however, it can also be written without the rest of the report. Hence, it should be complete and concise in every sense so that reading it is sufficient for understanding the topic.

5.2.5.1. Need of Executive Summary

Executive summary serves following needs:

1) **To Provide an Assessment of the Topic:** The executive summary is written with a motive of providing an assessment of the complete topic briefly. Therefore, it can be said that it acts as a navigational tool.
2) **To Help Readers:** The prime purpose of an executive summary is to help readers in deciding whether they need to read the complete report or not as it is the complete enumeration in itself.
3) **To Channelise the Ideas and Thoughts:** Executive summary strives to channelise the ideas and thoughts of readers in the direction of research work that has been covered in the research report.
4) **To Set Priorities:** Executive summary attempts to set the priorities of topics in the research report as per their importance in the research work. It allows the readers to identify the significant and considerable areas that have been covered.

5.2.5.2. Process of Writing an Executive Summary

The process for preparing an executive summary is as follows:

1) **Read the Entire Document:** Before preparing an executive summary, it is required that the researcher reads the entire report thoroughly and carefully. The researcher should take notes and should highlight the important concepts, theories, findings, suggestions and recommendations so that all these information can be properly included in the executive summary. The researcher should always remember that all the significant information should be included in the research and accordingly he should organise his ideas.
2) **Highlight the Important Points:** As soon as the notes have been prepared, the researcher should outline the points that are needed to be highlighted. The researcher should make sure that these points are essentially covered in the executive summary so that it explains the entire research work properly.
3) **Identify the Main Sections:** After highlighting the important points, the researcher identifies the important sections that are needed to be covered essentially. It can be done only after analysing the information that each section provides and comparing with each other. In this step, the researcher writes few lines that describe the main idea of these sections. The format for writing this part may differ across varied types of research, however, the principle elements that are essentially included are as follows:
   i) An opening statement giving a brief introduction,
   ii) Objective of research,
   iii) Methods of collecting and analysing data,
   iv) Description of findings, and
   v) Recommendation and suggestion along with satisfactory reasons.
4) **Combine the Information:** In this step, the researcher combines all the collected information and formulates a summary describing the essence of research. An important point to consider in this stage is that the executive summary should not exceed beyond 10% of the entire report. This implies that it should be written precisely and should also include the recommendations that are given in the report. The words and terminologies that are used may vary as per the types of readers and their interests. Some of the important points can also be highlighted using bullets which will enhance the appearance and effectiveness.
5) **Re-check the Summary:** After writing down the executive summary, the researcher re-reads this summary to make sure that it has been written appropriately. It should be checked in this stage that it is complete as an independent document also.

5.2.5.3. Guidelines for Writing Executive Summary

The guidelines that should be followed while writing executive summary are as follows:

1) **Clear Objective:** An executive summary should clearly discuss the objective of the research, the methodologies adopted, the finding(s) and the recommendations of the research work. It should concisely delineate the significant information that justifies the recommendations and suggestions.
2) **Proper Length:** Mostly the executive summaries are 1-2 paragraphs long, however, these should not exceed beyond the 10-15% of the entire report.
3) **Completeness:** Executive summary should be written in such a way that it can communicate the research work independent of the report. Hence, the researcher should check whether the summary is complete in itself or not.

4) **Concise and Coincide:** The executive summary should be concise and should not include the detailed descriptions regarding the subject matter. Also, the information in executive summary should coincide with the rest of the report.

5) **Checking of Spelling and Grammatical Errors:** There should be no spelling and grammatical errors in the executive summary. The researcher should not only rely upon the spellchecking application but should manually read the summary to ensure the correctness of language.

6) **Organised:** The description in the executive summary should be written according to the sequence of the sections in report, so that it can be organised and is comprehensive.

5.2.6. Introduction to the Report

As the name suggests, this section enables the reader to get comprehensions of the research study. It introduces the reader with the topic and gives an idea of the entire research study. It also states the problem (that triggered to pursue this research), its significance, different aspects and any earlier researches already done in this regard.

This segment of introduction depends upon the reasoning, thoughts and the writing being incorporated in the research problem and the objectives of the research. Making the readers understand the subject of research and the report is the main objective of this segment which will enable them to comprehend the research objectives and the problem. However, something more is required for a better understanding. Therefore, this segment also includes a general idea of the methodology applied alongwith the explanation of the different areas of study or industries, policy or institutional settings and other related materials.

The introduction page gives a brief review of literature or a small part of the complete literature review for the readers. Specifically, this section covers following details:

1) **Topic or Subject Matter:** In a research report, its subject matter or the research topic forms the basis of entire report and research study. It clearly describes the researcher's aims and objectives of the study in a complete, single statement. The subject matter generally revolves around the problem statement of the research study. The problem statement focuses on including the subject matter that has to be addressed and offered to a problem-solving team before they move towards finding its solution. Here, the researcher offers several reasons as to why the research is worthy of pursuing or why the readers would like to further read the report or why should someone support or invest in that study. The manner in which the results of the study will be utilised can also be used by the researchers to support their reasons. They can also explain the importance of the research topic.

2) **Purpose:** The purpose of the research study should be clearly stated so that the reader is able to understand the scope of the report. The specific objectives of the study are identified by the purpose statement. It is usually mentioned in the introductory section of the report so that the reader gets a robust and deep understanding of the scope and benefits of reading the report.

3) **Statement of Hypothesis:** A hypothesis may be referred to as an assumption, prediction or an educated guess formulated by the researcher that needs to be validated conducting appropriate tests. Professional or expert assistance regarding the formulation of hypothesis and thesis might be sought by the researcher if they are not familiar with the same.

4) **Assumptions:** The general topic of the research study is called the research proposal assumption. It comprises the thesis statement, method of validating it and the bibliography. It is either in the form of paragraphs or a summary. A final research paper can be written by using the information generated after evaluating the proposal assumption. Formulating research proposal assumptions require concentrating and brainstorming on ideas.

5.2.7. Statement of Objectives

The objectives of the research report should be clearly stated. This will allow the reader to understand the scope of the report. In fact, it is advised to mention the overall problem including the process of resolving it whenever a specific study is a part of a larger problem. Some brief background context regarding the causes of the problem alongwith any other similar researches (if any) conducted in this regard is also suggested to be mentioned here as they offer a better understanding of the study to the readers.

A purpose statement may be regarded as a declarative statement as it briefly outlines the particular objectives and topics of the study. An effective purpose statement has to be:

1) **Precise and Specific:** A purpose statement should be clear, unambiguous and exact.
2) **Concise:** It should be written in not more than one or two sentences.
3) **Goal-oriented:** It should emphasise on achieving the desired goals.

Importance of Statement of Research Objectives

The research objective statement is useful in following situations:

1) Finding out answers to certain questions by applying scientific methods.
2) Getting familiar with a certain phenomenon or gaining new understandings about the same (known as exploratory research).
3) Presenting the features of a specific person, group or a situation accurately (known as descriptive research).
4) Discovering the facts which have not been discovered till now.
5) Hypothesis testing between variables of a cause and effect relationship.
6) Finding out the rate of occurrence of something or its relationship with anything else (known as diagnostic research).

5.2.8. Literature Review: Analysis of Previous Research

A comprehensive and analytical study of the previous researches and documents is known as a literature review. With the help of literature review, the reader gets the background context of the study at hand. This section not only explains the findings and investigations of any similar researches done in the past but also presents the degree of knowledge and preparation of the researcher to carry on with further research. It presents an abstract or outline of a specific part of the research which guides the reader through the research program.

A good review of literature explains the reasons as to why a specific research problem/question has been chosen. It presents an outline of the research study in a written and systematic form. It also tries to depict the gap present between the curiosity of the researcher and his/her knowledge about that particular topic.

5.2.9. Research Method

This segment of the research briefly explains the different methods that have been opted during the research study and preparation of the research report. It also provides reasons for choosing a particular method. The various research methods involve choosing appropriate research design, techniques of data collection, sampling, data analysis and so on. This enables the reader to get an understanding of the technicalities and procedures involved in the research. Use of complex terminologies that are difficult to be understood by the readers is not recommended. The length of the research method description should neither be too long nor too short. The time required to finish the preliminary steps of the study is also to be stated here.

In detail of the aspects associated with the research methodology are as follows:

1) **Research Design:** This aspect states the appropriate research design chosen for the study alongwith suitable reasons for choosing the same. The different research designs opted in research are descriptive, causal or exploratory research.
2) **Sampling:** The information regarding sample alongwith suitable reasons for its selection is mentioned here. This provides the readers with insights about the sample used in the research study. The sample information describes nature of population, sample size, sample frame, sample units, technique of sampling and so on.
3) **Data Collection:** Data collection is an integral part of Research methodology. The researcher describes the appropriate techniques chosen for the collection of data alongwith suitable reasons for such selection. The sources of data collection – primary or secondary data, is discussed by the researcher in research methodology section. The methods used to collect data can also be described here, **for example**, interview, observation, questionnaire and so on. A copy of the questionnaire has to be included in the annexure, if the method of collecting data is a questionnaire.
4) **Fieldwork:** This segment describes the information regarding the fieldwork employed in the research. Details about the number of fieldworkers hired, the type of training they went through, controlling and monitoring their work, safety measures employed, etc., can be mentioned here.

5) **Data Analysis:** This segment explains the appropriate methodology chosen for data analysis alongwith suitable reasons for such selection. Detailed information is provided regarding the type of process used and calculations done for the data analysis. Here, the researcher may also use graphs and charts which will make it easier for the readers to relate the data. The annexure given should include the complex formulae used for calculations. Suitable reasons for the usage of a formula have to be stated in the footnotes along with the calculations.

6) **Findings:** This segment includes the interpretations and generalisations about the findings of the research as made by the researcher. These research findings should be capable enough in answering the research questions. It is also important to note that since research findings assist in the process of decision-making, therefore they should be presented logically. Use of graphs, charts and diagrams by the researcher can help in representing the findings effectively.

7) **Limitations of Research Project:** There are always certain limitations associated with the research study. These limitations that could affect the reliability of the findings of the study are also stated in this segment. These could be in the form of errors in sampling, data collection or analysis and so on. These limitations not only enable the readers in the assessment of the research findings but also provide room for improvement in the research. However, it should be kept in mind that the overstatement of such limitations could have an impact on the benefits of the research study.

5.2.10. Interpretations of Results

While preparing the research report, the researchers should choose the best way for conveying the information to the readers. This proves effective especially when complex images, terminologies, numbers, and other data have been used by the researchers to establish and support their opinions. In a simple sense, **figures**, **texts** or **tables** can be used to summarise the data. The textual data summaries are often helpful in conveying simple results of the research.

Conveying the research results clearly in one or two sentences can be regarded as a good principle. This avoids the use of figures or tables in the report. However, the researchers can make use of figures and tables if the data comprises numbers or is so complex that it cannot be conveyed in one or two sentences. This will also avoid text cluttering. Some other benefits of tables and figures for the readers are that they are helpful in taking quick references and presenting relationships, trends and patterns in a way that would have otherwise been difficult to understand if they were in the form of text.

Importance of Interpretation

Appropriate interpretation of the research findings is important for enhancing the usefulness and understandability of the research study. The points given below summarises some of the basic reasons due to which interpretation is essential:

1) **Facilitates Understanding:** Interpretation enables the researchers to understand the principle(s) working behind the findings. It also helps them to develop a link between the findings of study at hand and other studies working on the same principle which will in turn help in making predictions regarding the actual events of the world. Further investigations can help in validating such predictions in the future. This will help in maintaining the flow of the research.

2) **Develops Explanatory Concepts:** One can establish explanatory concepts with the help of interpretation. These concepts not only act as a source of guidance for the subsequent researches but also open up pathways for intellectual adventure and encourage more knowledge investigation.

3) **Depicts the Relevance of Research:** It is only through interpretation that the researchers can assess their findings and make others realise its importance.

The researchers can shift from exploratory research to experimental research using the interpretation. This is due to the fact that interpreting the findings of exploratory research leads to the hypothesis formulation for the experimental research. There is no need for the formulation of hypothesis for exploratory researches; therefore their findings are interpreted after the analysis of facts. Such interpretation is referred to as 'post-factum interpretation'.

5.2.11. Conclusions

Researcher after thoroughly analysing the processed information draws conclusions about the research. These conclusions are always in accordance with the objectives of the research. There should be a particular conclusion for every objective. These conclusions should be listed in accordance with the sequence of objectives. In case the researcher is unable to find out the conclusion related to a particular objective, an acknowledgement is included in the conclusions rather than hiding it.

There is a difference between making conclusions and giving recommendations. The conclusions are derived from the research objective and the analysis done by the researcher. However, for it to become a recommended course of action, the researcher needs to be aware of the financial resources of the company, its strategy, its operating, and general policies. Sometimes, researchers are strictly forbidden from making recommendations. Giving recommendations requires extensive knowledge of the research problem, background and resources of the organisation and all the optional methods of solving the problem. The majority of researchers may not have such knowledge. The researchers who have limited knowledge about the policies and background information of the organisation should not engage themselves in making recommendations, even if they are required to do so.

Conclusion, being the last activity of the report preparation, includes bringing together all the collected information and correlating them with the research objectives. All the thoughts and observations of the researcher included in the report are compiled together to discover final outcome or information. Here, no new invention or information is provided by the researcher which is not already mentioned in the research report.

5.2.12. Suggestions and Recommendations

Providing suggestions and recommendations to the concerned persons is another important part of preparing an effective research report. For the researchers, while it is essential to provide conclusions of the study, it is not always necessary to give recommendations and suggestions in the report. At times, the researchers are purposely requested for not giving any suggestions regarding a particular research study.

Providing suggestions and recommendations is not recommendable especially when, the researcher has incomplete information about the functioning of a particular company or its policies even if he has worked on the research study. It clearly sets out an essential criterion for providing suggestions and recommendations in research report, i.e., having proper knowledge about the subject under consideration.

With suggestions and recommendations, the researcher finally gets the opportunity to provide future guidelines about a particular study to other researchers. The section of suggestions and recommendations clearly explains the expected outcome of research along with the necessary information regarding various aspects such as objectives of the research, aims of the research methodology adopted by the researcher, scope and significance of the chosen research topic as well as its future applications. The section of making conclusions gains the maximum interest of other researchers and scientists. Hence, by all means, the researcher has to explain his findings of the research work.

Recommendations can be provided based on both the personal experience of researcher and previous researches. **For example**, an automobile engineer might want to change the four-stroke engines of a firm in which he works. The researcher of this field might provide suggestions on machine design, its compatibilities, oils and fluids and other engine dynamics, as he has personal experience in this field.

The basic components of suggestions and recommendations are listed below:

1) **Restatement of the Problem:** At the end of theoretical papers, a restatement of the problem along with the discussed result(s) is included so that a brief summary of the research work can be extracted.
2) **Description of the Procedures:** It involves a short description of the vital steps taken in the research work.
3) **Major Findings:** In this part, the key findings, the hypothesis made, the research design, and the decision of accepting or rejecting the hypothesis are stated.
4) **Recommendations for Future Researches:** In this part, the researcher provides suggestions for improvement in the work study, probable hypothesis, and future researches.

5.2.13. Limitations of the Study

Limitations are a significant part of the research report. This segment covers the scope of research beyond which it cannot be applied. These limitations and constrictions make an impact on the outcomes of the research. The limitations of the study can be described as those restraining factors of the research methodology or design that affect the applicability or interpretation of the research outcomes. Limitations act as constraints in the usefulness and generalisability of the research outcomes. They result due to the selection of a particular type of research design or the method for establishing the external and internal validity by the researcher.

The limitations at the point of preparing the research should also be stated which will help the reader in judging the extent of reliability of the research results. This will further be helpful for those researchers who wish to continue the study on the similar topic or a related one. Other people will not criticise the methods or outcomes of the research if the report contains the limitations or exceptions of the study. By including limitations, the researchers admit the fact that their methods of research or other different aspects have certain restrictions. **For example**, if the research methods have some limitations, then those should be stated in the research methodology segment of the research. But there are some formats of report that suggest stating the limitations in a different segment (may be in the conclusion of the report), however, it is upto the researcher to decide as to where it should be stated.

5.2.14. Reference Section

This is one of the most important sections in the research report. Researchers should properly quote the references taken from other research papers in their reports. This section generally includes appendix, bibliography and endnotes.

1) **Endnotes:** This part includes the sources of information that a reader might wish to know. **For example**, the name of publisher, its date and place of publication, title of the study, the name(s) of the author(s) and the particular page numbers of those sources.

2) **Bibliography and References:** Bibliography is a list containing all the books, journals, articles, reports, interviews, websites, video or audio recordings, etc., that has been referred by the researcher during the research work. It is generally arranged in alphabetical order and appears at the end of the research report. The bibliography thus enumerates the various secondary sources accessed by the researcher for the purpose of the research. It thus helps the reader to understand the work undertaken by the researcher and also acts as a platform for future research works.

   The citations in bibliography include various details like name of the source, author of the source, name of publishers, data of publishing, and the number of pages. It takes a lot of work on the part of the researcher to gather the references for his work. The bibliography thus bears testimony to the hard work done by the researcher and the originality of research. Since the bibliography also mentions the date of the source, hence the reader is able to estimate the time-duration of the information and thus can form an opinion regarding the relevance of information.

   Generally people consider the bibliography and reference to be the same. But both are different and are used differently for various researches. Bibliography is the listing of sources at the end of the book or research, whereas references are named within the text of the research. These references are utilised to support a particular statement or claim in between the text. Therefore, references are used for creating a particular information or statement in a more trustworthy way.

3) **Appendix:** An annexure or appendix is the supporting document which provides additional information about the research that cannot be included in the main body of the report. It is placed at the end of the report. The more concise the report, the more comprehensive it becomes. The annexure or appendix usually contains the details like definitions, detailed maps, explanation of maps, formulae, basic calculations, etc. Therefore, annexure is very useful for providing additional or supporting information to few relevant users who need detailed information. It is also helpful in supporting diagrams and statistics which is generally skipped by the reader. Here, few specific abbreviations, technical terms, and symbols may be described for specific users.

5.3. REPORT WRITING

5.3.1. Introduction

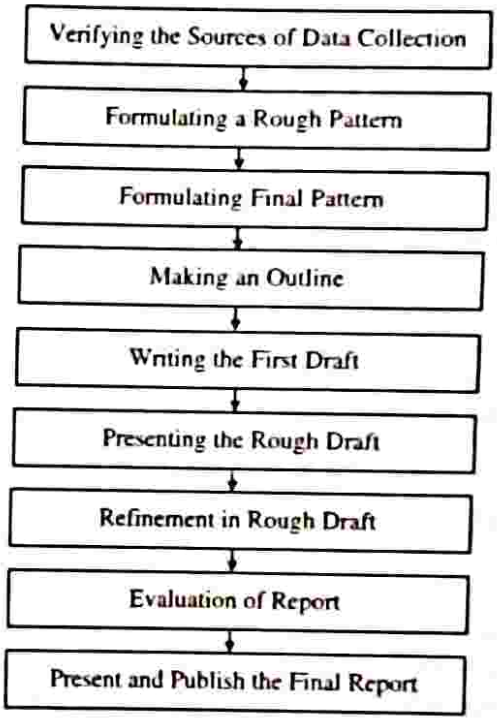
Project report is the written way of communicating the results of an investigation. It is a document which reflects about how the research is conducted, the care that has been exercised throughout the study and the findings in a manner that can be utilised for decision-making. It is observed that executives are rarely interested in the methodology adopted by the researcher in the investigation; they are interested only in the final results. From their viewpoint, the research report is the written presentation which the executive see about a project carried out by the researcher but initiated by the decision maker (executive) and it conveys the information desired by the decision maker in an understandable form.

Report writing is an art, which must be learnt through hard work, practice and effort. The information and recommendations placed before the management are of little value unless they assist in making judgements and lead to decisions. Therefore, a report should be written very carefully so as to stimulate thought and lead to action. Report writers should concentrate on the collection of relevant data, organising the data and arriving at a conclusion. The contents of the report play a very important role in stimulating action.

5.3.2. Process of Writing Research Reports

Preparing a project/research report is not an easy task. It should be written with perfection as any wrong information may mislead and confuse the readers. Writing research report is one of most important tasks in the entire research process, as it allows the researchers to present it in front of the managers so that they can make decisions and take actions accordingly.

The steps needed to prepare the project report are as follows:


Verifying the Sources of Data Collection
Formulating a Rough Pattern
Formulating Final Pattern
Making an Outline
Writing the First Draft
Presenting the Rough Draft
Refinement in Rough Draft
Evaluation of Report
Present and Publish the Final Report

1) **Verifying the Sources of Data Collection:** Verification of the sources of information is a fundamental task which should be carried out prior to the preparation of research report. The information can be collected from various primary and secondary sources. More important is the research issue, more is the verification needed.

2) **Formulating a Rough Pattern:** During the data collection, researcher notes down the significant and related information that can be included in the research report. As the researcher proceeds in noting down the information, he formulates a pattern to identify relevant and irrelevant information.

3) **Formulating Final Pattern:** On the basis of formulated rough pattern, the collected data is analysed. While analysing the data, the researcher might feel the need to collect more data, while some of the existing data may get rejected because of their unsuitability. By analysing collected data, gradually the final pattern of the research report is formulated which is continuously refined.

4) **Making an Outline:** After formulating the final pattern, an outline of the research report is made, where the researcher decides how to present the report. Various decisions to be made in this stage are related to problem statement, arrangement of various sections, and a logical sequencing is decided. Many times it is not needed, but it helps in finalising the structure of report.

5) **Writing the First Draft:** The next step is writing the first draft of report. It is a rough draft which is prepared by researcher at first. In this stage, the researcher is still in confusion between the notes and the outline of report. Hence, this draft needs refinement till it is finalised.

6) **Presenting the Rough Draft:** In this stage, a rough draft which is prepared in previous stage, is presented in front of the management. It is very important for a researcher to make the management understand what

the report is trying to communicate. While preparing rough draft, it should be kept in mind that the language should be clear as well as appealing. The researcher should note down all the suggestions that are given for the improvement.

7) **Refinement in Rough Draft:** In this stage, all the refinements that are suggested by the management are made in the draft. The researcher also needs to carefully analyse the draft and make necessary changes such as adding important details, rearrangement of text, checking of grammar and spelling, etc. This refinement continues in a loop till the top management approves the report.

8) **Evaluation of Report:** After continuous refinement, an almost final report is prepared. In this stage, the top management evaluates the effectiveness of report. They analyse whether the research is completed as per the instructions or not. In this step, the reliability and the validity of the report is checked against set parameters. The report is effective when it is able to communicate the purpose of research clearly and comprehensively without hampering the quality of the report.

9) **Present and Publish the Final Report:** Once the report is finally approved after evaluation, the next thing is presenting it to the intended audience. The presentation should be effective enough to get the attention about the research objectives. This presentation can be enhanced with the help of diagrammatic representation and hand-outs, interaction with audience. Once, the report is successfully presented, it is the time to publish it so that general public can get to know about the research. Organisations can inform the common public with the help of various techniques, such as, bulletin boards, newsletters, etc.

5.3.3. Writing the Draft

After completing the outline, the placement of graphics, charts and tables can be decided. Each one of these should be placed according to the section they belong or represent in the outline. Before start writing, first approximation of the graphics will be quite helpful even though it is possible to add the graphics later or changing the tables into charts.

Different writers use different techniques for translating their thoughts into writing. Some writers will prefer to use long hand depending upon others to record their texts into a processed format. On the other hand, some other writers can prefer to use the word processor which will facilitate them to add, delete and move the various arts as per their comfort. The decision will be made on the basis of the best method to use.

Spelling errors are generally checked using computer software and a thesaurus is provided for finding the alternative term for expressing a thought. A 20-volume Oxford English Dictionary can be used with the help of a CD-ROM which is considered to be the greatest dictionary in all the languages. However, standard spelling checkers are not able to detect common word confusion like effect for affect, to for too, there for their, etc. In this respect, advanced programmes can inspect the report for grammar, doubled words, homonyms, punctuation, capitalisation, style problems, and readability level. Inappropriate phrasing and distorted words will be disclosed by style checker.

5.3.3.1. Role of Audience

An active role is being played by the audience in any kind of writing situation. Similar to an actor in any drama, a part is also being played by the audience with the help of document as a "script". Once the information is obtained in the document, some actions are being performed. It is the decision makers and the users who take the most active roles. Users require document which serves as an instruction manual for physically carrying out some process. On the other hand, decision-makers need documents that give them required information for taking informed decisions.

A good writer modifies the document in order to manage different roles of the audience. There can be similar topics (with the identical sub topics) but there can be a lot of variance in the document mainly resulting from the varied role of the probable audience. In order to determine the role of the audience, following questions should be asked:

1) **Who will Read this Document?:** The audience could take any form that is a single individual (supervisor), a group of limited number of individuals (members of a committee) or a relatively large groups (the probable reader of a user manual). The researcher may have both the audience i.e., a primary audience, the audience to whom the document is addressed, and a secondary audience, audience who refer the report for gaining information and not directly for taking any action.

2) **What is the Audience's Need?:** Why the content of the document is important for the reader? The document must ensure that the content should be able to fulfil all the objectives for which it has been prepared. It should have knowledge of the relevant problems and issues, so that it is able to keep the customers satisfied with company's product and service. The information must be utilised differently for the different individuals including the customers and various other stakeholders in the organisation.

3) **How does Writer's Goal Fulfil the Audience's Need?:** The main objective of being the writer is to equip the audience with useful information that helps them to take some action. By developing certain message which has specific objective can serve this purpose. Following two questions need to be answered in this context:

i) What is the core message?
ii) What is the main objective?

Commonly, the message is nothing but the fundamental evidences which the researcher intends to present. The objective behind this message is to inform, guide or convince the audience. The combination of the two questions sets out the goal. **For example,** if the main objective of the report is to provide information about the outcomes of a survey, a memo should be used by the researcher which can facilitate the reader to find relevant data. If the objective is to motivate the reader to act in a particular manner, report should be used by the researcher pointing out the importance of the data and the actions which can be taken based on them.

4) **What is the Audience's Task?:** Once reading is over, what will the reader do? This is the main reason behind the involvement of the audience in the situation. There are number of reasons for such involvement, but the key reason is to acquire right kind of information needed by the reader for taking action towards fulfilling his role.

The various effects of the requirements can be easily seen by the researcher by taking into account two audiences – machine operators and departmental managers. Both the groups require information, but their different needs demand different information. Operators require knowledge about the order or sequence of steps that are followed for running the machine, turning it on and off, troubleshooting it, etc. Managers want to know usefulness of the machine for the workstation. They want information about machine's capabilities and weaknesses, and if it will benefit the staff or not. They want information about the output capacity of the machine; whether its output can flexibly be changed according to the changing demands for production. Also information related with personnel is required, that is if they will be able to undertake the operational activities without any external help and issues like if machine jamming can be easily fixed by them.

As there can be variation in the tasks and the requirements, there can be different documents which are directed at each of these. **For example,** the operator requires a detailed instruction manual, explaining the sequence of steps with pictures and drawings, besides, an index for finding the required information quickly.

5) **Is there more than One Audience?** There may be situations when the readers of the document are more than one. Under such circumstances, the writer needs to decide which audience to target, primary or secondary. The primary audience refers to the person who is directly referred to in the document. On the other hand, secondary audience is the one who is not targeted at the time of preparation of the report, but who will also read the information contained in the document. The document must be formal because generally the secondary audience and the writer are quite far from each other. The below mentioned examples can be used to depict how a document can be changed by the writer to address both the primary and secondary audiences.

For example, where a memo is to be written to supervisor requesting him to grant money for travelling expenses to a convention, it should be remembered that the memo is for supervisor's reference only. The supervisor needs the memo for records purpose only. As such, an informal memo addressed to primary audience might read like this:

January 20 , 2018
David,
This is my formal request for $650 on account of travel money for delivering the speech on the subject of widgets to the annual Society for Personality and Social Psychology convention in San Francisco in April 2018.

Thanks a lot for your help for this purpose.

Austin

It is this brief note that supervisor wants. The note should not be lengthy (with spaces and table of contents). Besides, a formal business letter is also not required. In fact only a brief note is more than enough for the supervisor. The form and the contents of the memo are mainly governed by the requirements of the primary audience.

Now, let us consider that this memo has to be presented to the manager of the supervisor for the approval. Here, using a short and informal memo is not desirable. The manager may not know the purpose of the trip or the work involved in it. As such, a memo to the manager should be different and should be like this:

Date: January 20 , 2017

To: David Marshall
From: Austin
Subject: Travel money for delivering speech to Society for Personality and Social Psychology convention.

As I have already informed, I have been invited as a keynote speaker at the Annual Convention of the Society for Personality and Social Psychology in San Francisco. On account of this, I request you to kindly issue $650 to defray part of my expenses for that trip.

This group will be printing the speech in the conference Proceedings and thus our work in social psychology will have the opportunity to have a wider readership. Even an expense of $350 will be paid by society in support but the total estimation of expense in the entire trip is about $1000.

I will be out of office for four days, i.e., 1st to 4th March; In my absence, my normal duties will be taken care of by Warren Lang. I request you to kindly provide me the appropriate time so that I can brief you with the relevant information.

There is a lot of difference between the two memos. The second memo is more formal in language and relationship. It highlights on the importance of this trip in order to provide relevant information required by the manager and the secondary audience for having a positive response.

In order to attain greater readership, thoughtful writers take into account the reading ability of their audience. A writer can obtain greater readership if the topic of the writing appears interesting to the reader and is related to his field of study. Apart from this, the efficacy of the report can be portrayed by the writer by elaborating how the report will benefit the readers. Lastly, the writer may write at a level which is consistent with the reading capability of the audience/reader. A standard readability index can be used for testing the difficulty level of writing. A score between 0 to 100 is assigned by the Flesch Reading Ease Score. If the score is low, it will imply that the material is quite hard to understand. A score which matches with the grade level for easy reading and understanding of the document is provided by Flesch-Kincaid Grade Level and Gunning's Fog Index. There are some special software packages which can be used for calculating the indexes automatically; however, it is also possible to determine these manually. The most advanced software enables setting the preferred reading level. Any word that is above that level is automatically highlighted in order to facilitate selection of alternate word.

Those who favour the readability measurement do not have any claim that only the simplest possible level should be used for each written material. They favour only that level of material which is suitable for the readers. They claim that the comic books has a score of 6 on the Gunning scale (i.e. a person who has literacy level equal to 6th standard will also be able to read that material quite easily). Time scores around 10, whereas, the Atlantic scores around 11 or 12. People find it difficult to read any material which is beyond 12. However, such measures generally give only a rough estimate of the exact readability level of a report. As such, good writing requires a host of other skills to improve the reading ability of the readers.

5.3.3.2. Comprehension

One of the characteristics of good writing is that it varies with the objectives of the writing. Research writing is aimed at providing information of a certain nature. The writer should aim at avoiding all sorts of ambiguity, words conveying numerous associations, and allusions. Care should be taken to use the most appropriate words, words that explain thoughts precisely, clearly, and efficiently. Wherever constructs and concepts are used, their meaning should be properly explained, either operationally or descriptively.

Care must be taken while organising and editing the words and sentences. If the reports are written carelessly, misplaced modifiers can be seen in abundance. When secondary ideas are mixed with primary ideas, the report becomes confusing for the readers. This forces them to sort out primary ideas from secondary ones, which should have been done for them.

Finally, the concern is regarding pace of report which can be explained as:

The rate at which information is provided to the reader by printed pages. The appropriate pace of writing enables the reader to minimally use his brain while he reads the document. When the information that is presented is complicated or technical in nature, it becomes difficult to understand. Whereas, when the information is presented in simple and common language, it is relatively easy to understand it. The pace is really fast if the brain of the reader is not able to catch with his eye movement. On other hand, the pace is slow, if the reader's mind is moving fast in comparison to his eye movement. Thus, accurate pace is one in which both brain and eye of the reader moves with the same speed.

If the document is full of concepts, there will be too much information in each sentence. In comparison, there will be very few ideas in each sentence in the sparse writing. Various methods are used by the writers to modify the writing pace:

1) A lot of white space can be used with wide margins so that a positive effect can be created on the reader.
2) Large text can be broken down to smaller units with associated headings to represent arrangement of topics.
3) Wherever possible, difficult matter must be accompanied by visual aids.
4) Highlight important contents and non-important matter should be presented normally. This can be done through proper sentence framework, italicising, underlining, capitalisation, and parentheses of sentences.
5) Words should be selected cautiously. One should make use of more common and known words than unknown and complex words. Graduate students generally tend to use jargons, decorated constructions and long words. However, there are times when use of technical terms is required. This is more particularly true in case of scientific reports. Jargons are commonly used in scientists' communication but the audience generally lack scientific training and thus they look for greater assistance than most of the writers facilitate in understanding the technical terms.
6) Difficult and complicated ideas should be repeated and summarised so that readers get enough time to understand and grasp them.
7) Service words should be used strategically. They do not represent objects or concepts, but portray relationship. Transitional words like conjunctions are also service words just like phrases 'on the other hand', 'in summary', and 'in contrast'.

5.3.3.3. Tone

Effective use of tone is very necessary for enhanced reading effects. This underlines the approach of the writer and shows how much he understands the reader. The report should make a clever use of details and simplifications. It should highlight the facts and not the opinions of the writer. The report should be written in passive voice and should not refer to first person as far as possible. In order to give a positive image, recommendations should not be modified as per the taste of the reader.

For ensuring the correct tone, the writing should be reviewed. It is better to refer the reader but referring the writer himself is not advisable. According to an author, the use of word 'you' reflects that the report is written for the reader and not delivered by author. The message addressed to the reader should express sincerity, personalisation, warmth, and engagement on the part of author. This can be done by removing negative ideas and thoughts and replacing them with positive ones. In fact, phrasing should be reviewed. Check and decide which of following sounds most appropriate?

End users do not like the Information Systems Department to govern them about which software to purchase. They rather want more independence while deciding on the selection of software system.

Both the messages deliver similar information but the positive tone of the second message makes it quite easy for the Information Systems Department to accept the point of view without being defensive.

5.3.3.4. Final Proof

Final editing of the draft should be carried out atleast after a gap of one day. This is quite helpful in determining the errors and rectifying them effectively. A number of questions need to be answered in final editing, which may relate to organisation, presentation, and layout of the final report. This should be done more than once with each time focusing on different aspect of report in mind. The final stage of editing is followed by executive summary.

Before final execution of the research report, the researcher should take a short break (one or two days) and involve himself in recreational activities to refresh his mind. This will enhance his effectiveness in finding out the mistakes in the final editing stage. He should keep in mind following questions while reading:

1) Is the flow of writing smooth?
2) Does the report need any changes?
3) Does the arrangement of report appropriate for the reader?
4) If all the problem statement and research objectives are addressed by the findings and conclusion?
5) Are all the tables and graphs comprehensible?

Following completion of editing, the reader should write executive summary.

Guidelines for Proofreading a Research Report

Following are the guidelines for proofreading a research report:

1) The spellings of important names and terms like names of people and places must be double checked.
2) Ensure that all the used quotations are grammatically correct and fits into the sentences.
3) Avoid random use of informal language.
4) The titles of the work should be re-examined for ensuring the adherence of all the rules.
5) Every sentence should be checked to ensure that they have an end mark. If the ending of the sentence is done with a parenthetical citation, it must be ensured that citation is mentioned before the end mark. When there is a long indented quotation, end mark must be followed by citation.
6) Each quotation in the text body should be examined to ensure that quotation marks are used at the beginning and end of it. It must be ensured that quotations within quotations are enclosed in single quotation marks. The quotation should be set off the text if it is more than four lines long and should be indented instead.
7) Use of points of ellipsis should be done properly in edited quotations.
8) The researcher should confirm that parenthetical citation is used after every quotation, summary, or paraphrase.
9) There should be an entry in the Works Cited list related to each citation.
10) In order to ensure the accuracy, make sure that each quotation is used against the note cards.

5.3.4. Presentation Considerations

A presentation may be defined as a demonstration by a speaker to an audience, with the objective of providing them with a solution to a problem or imparting knowledge about a subject or product. Presentation is a two-way process where the speaker demonstrates his/her ideas and the audience evaluates the same, simultaneously.

The main aim of a presentation is to educate the audience on a particular topic, be it an idea or a product, in order to help them understand it better. This way, a presentation aims at benefitting both the audience and the firm. A presenter is required to not only possess skills that can effectively get the message across the audience but also be able to answer any queries that may arise during the process.

The following set of guidelines help make a presentation effective:

1) **Select Objectives and Presentation Topic:** The objective of a presentation, which may be to educate or influence an audience, must be well established. A speaker must present at an appropriate speed so as to neither bore the audience nor rush through the same. The topic must be such that the speaker has excellent

knowledge of and is, therefore, able to impart additional information to the audience during the process of presenting. Knowledge, experience, and confidence of the speaker are said to be the cornerstones of an effective presentation.

2) **Analyse the Audience:** As it has already been mentioned before, it is very important for a speaker to genuinely understand his/her audience. Factors that govern an in-depth knowledge of one's audience are age, gender, educational qualification, nationality, aptitude, etc. The speaker must respect each person's individuality. To keep audience engaged during the Q&A sessions, the speaker must address the entire group and not just the person posing the question. A speaker's behaviour must be such that the audience come to trust him/her.

3) **Select the Type of Presentation:** The next step would be to determine the form a presentation will take. Once the speech has been prepared, and the length has been confirmed, the speaker must decide how the same is to be presented to the audience.

4) **Decide upon the Audio-Visual Aid Needed:** To make a presentation more qualitative, the presenter must utilise audio-visual aids such as handouts, slides, videos, PowerPoint presentations, etc. The style, font, and colours used in these aids should be such that highlight the crucial points and are comfortably visible. The use of colours and patterns should make the display more appealing.

5) **Be Informed about the Venue and Equipment to be used:** A speaker must be informed of the venue beforehand. Prior to starting a presentation, the speaker must give the venue a quick visit to gauge the size of the room, determine what pitch of voice will make the speaker audible to everyone, and determine how the audience will be placed. The speaker must also be well aware of how the presentation equipment is to be used to avoid any confusion.

6) **Practice Presentation:** The speaker must be so well-rehearsed with the presentation that he/she is able to deliver it confidently to the audience, without any glitches. Sufficient time must be invested by the speaker in practicing the speech and researching the subject thoroughly.

7) **Make Body Language Effective:** Excellent body language is one of the most important tools that make a presentation memorable. A speaker's gestures must be decent, posture must be one of confidence, must make ample eye contact with the audience, have good control over his/the voice, and generally exude confidence and an approachable attitude. The speaker must also reduce referring to the written material to a minimum. A well-practiced speech will help achieve this.

8) **Prepare Assessment Form and Hand-outs:** Hand-outs are written material distributed among the audience at the beginning of a session to educate them on what will be discussed during the presentation, enabling them to follow the presentation simultaneously and help them take back what is discussed. These hand-outs or brochures must be prepared with utmost care as they are a means for the audience to not only understand the subject of the presentation better, but also pass this information on to peers who may not have access to the same. Assessment forms, on the other hand, are another means of improving a presentation. These forms are distributed among the audience at the end of the session to attain feedback on the subject of the presentation, how helpful it was, how they felt about the presenter's level of confidence and delivery methods, and any other suggestions that they may have. Based on this feedback the presenter can aim to alter his/her future presentations.

9) **Maintain Active Listening:** A good presenter must not only be a good orator, but also be an excellent listener. The traits that define a good listener are the ability to carefully and patiently listen to what the audience has to say and correctly comprehend it, while analysing the sentiments of the audience. This can be attained by being attentive, understanding what is being said, and carefully interpreting and analysing it, while simultaneously preparing one's response.

10) **Keep Continuous Eye Contact:** A nervous speaker will avoid making eye contact with the audience and render the presentation ineffective. A confident speaker, on the other hand, will make continuous eye contact with the audience and address the entire group. Speakers often use the 3-second rule where they make eye contact with a person in the audience for duration of 3 seconds, and follow the same rule with other persons in the audience from time to time.

5.3.5. Precautions in Writing the Report

Report writing can be considered as an art which is learnt through practicing and experience. While preparing project/research report, following precautions should be taken by the researcher:

1) **Accuracy:** A research report should contain accurate information about the research problem and research objectives as inaccurate information may mislead the managers and can cause problems in decision-making.
2) **Simplicity:** An ideal research report should be simple in every aspect. The layout, wording, grammar, phrasing, sequencing, tabulation, etc., should be developed with full attention to keep it simple.
3) **Clear and Completeness:** A research report should be clear and complete. These two terms are complementary to each other. Researchers should not use ambiguous words or sentences while preparing a research report. The report should be clearly defined in terms of its objective, scope, sources, findings, etc. The concepts and techniques of the report should be explained appropriately to make the research report complete in every sense.
4) **Conciseness:** The research reports should be concise and brief enough to represent all the information needed by the executives as they want the facts and results only. But this feature of research report should not be compromised with the clarity and completeness of the report. The report should be able to highlight the essential points briefly without damaging its quality.
5) **Comprehensibility and Readability:** Research report should be comprehensive and easily readable. There should be no confusion in the language or grammar of the contents. Technical language or terms should be avoided in the preparation of questionnaire. The language and content of the report should be in such a way that it can be understood by everyone.
6) **Reliability:** The information included in the research report should be reliable and valid. It is also essential that all important facts should be included so that readers may understand it easily. Researchers should prepare the report with special care such that the erroneous information should not be included, as it confuses the readers.
7) **Timelines:** The unique feature of research report is that it should be prepared within a stipulated time. Timeframe is the crucial aspect of a report, as data included in the report may become obsolete or irrelevant after certain period time.
8) **Logical Content:** All the contents of a research report should be written in a logical way. None of the information should be included without proper investigation and analysis. There should be a sequence applied to all the components of report. The entire report should be categorised into several parts containing distinct facts and information, and should facilitate the ease to locate the concerned topic in a report.
9) **Original Content:** The contents of a research report should be original and specific. The research report should address some specific problem. The researcher should attempt to provide a solution to the problem being addressed.
10) **Free from Errors:** The report should not contain any errors such as spelling errors, missing data, grammatical errors, incorrect calculations, etc. Researchers should ensure the report to be error-free before presenting it finally.
11) **Good Appearance:** Research reports should be well typed, neat and clean. It should maintain this consistency throughout the report, to catch the attention of readers.

5.4. ETHICS IN RESEARCH

5.4.1. Introduction

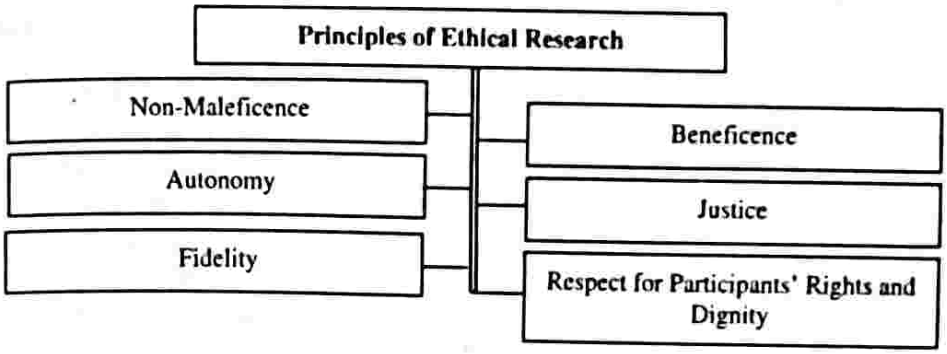
Research ethics deals with the responsibility of the researchers to show honesty and respect to the different persons who are going to be influenced by their research studies or their reports of the studies. Normally, researchers are expected to follow a set of ethical guidelines that guide them to take right decisions and take appropriate actions. Ethics can be seen as guiding norms or behavioural standards that direct ethical decisions related to our behaviour and our relationships with others. The ultimate objective of ethics in research is to ensure that no person is harmed or adversely affected due to research activities or due to research results.

Normally, all these objectives are accomplished. But the unethical practices are ever present and mainly relates to the violation of non-disclosure agreements, breaking participant confidentiality, avoiding legal liability, misrepresenting results, deceiving people, invoicing irregularities, etc.

The acceptance of ethics in the form of an issue by organisations was highlighted by one of the surveys, in which 80 per cent of the organisations acknowledged the devotion to ethical code of conduct. There is no particular approach to ethics. It is quite difficult to ask researchers to observe every piece of formulated ethical guidelines because of the obvious reason of research constraint. Ethical research simply demands honesty from researcher, project manager, and research sponsor. This makes ethics an important area of business research. Ethics is helpful in determining whether a particular action is right or wrong. As such, it is obligatory on the part of researchers that they strictly follow ethical practices. In this respect, volunteer involvement is the key to ethical research. It is a matter of fact that research cannot continue without public support from which data has been drawn. As such, the requirement of ethics is very much needed.

5.4.2. Principles of Ethical Research

The different principles of research ethics are stated below:



1) **Non-Maleficence/Do No Harm:** One of the important principles of ethical research is that people or animals part of the research process should not be harmed. It is very important to be aware of different adverse events that may happen during the research work as these events may be possibly intentional or unintentional, and therefore, cause harm. If there is any chance of happening unpleasant events due to research activities, it is required to have securest scientific surroundings for the researchers.

2) **Beneficence:** Besides being harmless, the research must also be beneficial for the society. Sometimes this criterion may put the researcher in tight spot because a thing may be beneficial for a group, but may not be beneficial for another group. The principle of beneficence is complexly related to the concept of competence. Individuals trained by professional institutions and recognised colleges are expected to be more competent than others. This implies that qualification or competence of researcher is of utmost importance. The principle of beneficence expects the researcher to conduct social and behavioural research that is effective and important in promoting the cause of social welfare.

3) **Autonomy:** The principle of autonomy states that it is the individual's choice whether or not to be part of a research process. No one can be forced to be part of the research, either overtly or covertly. The underlying theme of the principle of autonomy connotes the right of an individual to voluntarily participate in the research process. During earlier periods, in order to conduct the medical and psychological research, prisoners were used without their consent. The nature of the research project in which the participants have to participate must be informed to them in order to facilitate an informed decision related to their participation. Therefore, the principle of informed consent becomes quite vital. Informed consent requires that participants are duly explained about the nature of the project and the risks, benefits and outcomes expected from the project, before they agree to participate in it.

   Presently, participants are made aware of the nature of the research they will be part of and what procedure they will be required to follow. This allows them to make informed choices keeping in mind their health and socio-economic profile. Thus, research ethics requires delivery of full and clear information about the project to the participants. However, the principle of autonomy may distort the results of study. This is because people who participated in research may differ from those who do not participate (volunteer effect).

4) **Justice:** The assumption that all the individuals are equal lays the foundation for the principle of justice. Therefore, no discrimination should prevail among different individuals on the basis of their race, gender, disability status, income level or any other trait which can be utilised in the research.

5) **Fidelity:** Faithfulness and adherence to the agreements and promises between the participants and the researchers are depicted in the principle of fidelity. As such, any act of deception or violation of confidentiality will be treated as unethical practice infringing the rights of the participant.

6) **Respect for Participants' Rights and Dignity:** All the participants have human and legal rights. These rights should not be violated by any research project during the recruitment of the participants. The maintenance of dignity and self-respect of the participants is of utmost importance. At times, researchers may fail to realise that they are violating client's rights. Such instances should be reported and minimised.

5.4.3. Ethical Behaviour of Research

Ethical issues have acquired added importance in business research in the present era. There are a variety of ethical issues that business research has to face. Ethics can be seen as a field of inquiry that portrays the kind of behaviours most appropriate for given conditions, as per the code of standards laid down by the society. It is philosophy – deontology or teleology which governs the conduct of a person in an ethically sensitive situation. Organisations have laid down comprehensive ethical codes for both buyers and sellers of research in the research industry.

There are various ways in which the society may dictate acceptable and unacceptable behaviours. In order to deal with certain practices, which are not illegal, but are considered wrong in the context of industrial behaviour, necessary code of conduct are formulated by trade associations or professional organisations. This is quite evident in the marketing particularly in the case of marketing research. Different types of codes of ethics are formulated by the Qualitative Research Consultants Association (www.qrca.org), the Council of American Survey Research organisations (www.casro.org), the Marketing Research Association (www.mra-net.org), The American Marketing Association (www.marketingpower.com), and the Canadian-based Professional Market Research Society (www.pmrs-aprm.com). Throughout the world, greater attempts are made by the marketing research organisations to attain the higher ethical conduct among the marketing research practitioners.

Codes of Ethics

Many organisations formulate ethical codes. The codes of these organisations, more or less, concern following areas:

1) Prohibition of selling (Sugging) and fund-raising (Frugging) under the impression of a research;
2) Ensuring fair treatment of clients and suppliers; and
3) Ensuring research integrity by checking misrepresentation of facts and deletion of relevant data.

5.4.3.1. Sugging and Frugging

Sugging can be defined as "selling under the cover of a survey". Generally, sugging takes place when during the research study, the researcher obtains the cooperation of the respondent and with the help of that the researcher tries to sell goods or services to the respondent. There are many customers who are willing to share their attitude and opinions regarding some specific products or services when legitimate request is made to them. This goodwill created is utilised by Suggers (and Fruggers) by misleading the trusting customers. But after some time, the customers come to know that their approval of responding some specific questions has led them to face a sales presentation.

There is no such intention in sugging and frugging to collect and analyse data for definite purpose. Here, the only intention is to sell or make money through a fake survey. Consequently, it becomes difficult for the researchers to find true and cooperative respondents.

Frugging is quite similar to sugging and signifies "fund-raising" under the impression of conducting a survey. As no direct sale of a product or service is involved in frugging, it is not illegal in nature. However, it is generally regarded as an unethical practice. In reality, telemarketers or other direct marketers are generally involved in sugging and frugging. No sugging and frugging activities are conducted by the researchers. But as these activities are associated with respondents in any research, these are considered in research ethics.

There is a common understanding in the business research industry that attempts must be made to affect legislation in such a manner that it can have some favourable impacts on industry.

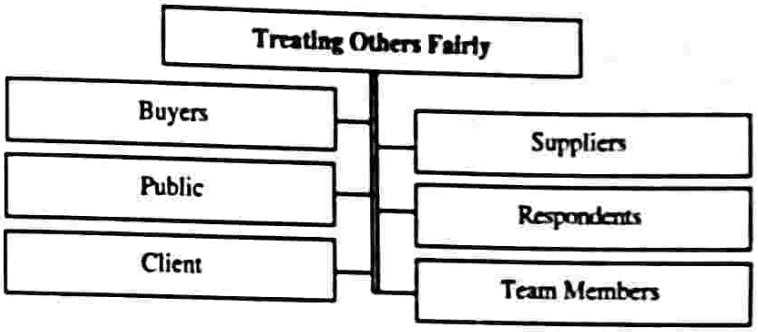
5.4.3.2. Research Integrity

There can be instances in which research is not objectively conducted. Information is kept secret, falsified or changed to protect the interest of certain individuals. Vital marketing decisions are made with the help of marketing research information. These decisions have a tremendous impact on company's strategy, jobs, organisation, budgets, etc. When there are so many things at stake, it is obvious that the researcher may lose objectivity in the research process. The loss of objectivity or integrity in research is generally reflected in actions like information concealment, data falsification, modification of research results, or misinterpretation of research findings in a way that makes them consistent with previous findings.

The encouragement to violation of research integrity may come from either the buyer or the supplier. The seller of research may withhold the information or change the material content of the report in order to present report according to wishes of the buyer. There is no requirement of separating the research integrity breach with the individuals who manage the research project. It has been found that interviewers conducting interviews may adopt short-cut ways in order to complete their survey in time. There is evidence to the fact that this is a bigger problem than was earlier thought. As such maintenance of research integrity is of utmost importance in research industry.

5.4.3.3. Treating Others Fairly

While practicing business research, a number of ethical issues may arise which are concerned with how others are treated. There can be an unethical treatment of the buyers, suppliers and even public. They are discussed below:



1) **Buyers:** The fair treatment of the buyer firms is one of the most commonly faced ethical issues which are witnessed by many marketing researchers. The typical examples of unethical treatment include overlooking study requirements while subcontracting work, charging hidden charges from buyers and sale of needless reports. Suppliers convince the buyers to have more expensive research design in the research work and in this way; they charge higher prices from the buyers for maintaining the quality of the work.

   Further, dissemination of personal information also raises ethical questions. Almost all the work of research firms is confidential and proprietary. Researchers build kind of warehouse of this information as they are involved in a number of research studies. All the ethical issues concerning confidentiality centre around treatment of this storehouse of information.

2) **Suppliers:** Even the suppliers of the marketing research are abused by the buyers. Sometimes, the firms capable of conducting the research internally, request the proposals from supplier marketing research firms just to get the idea of the cost incurred on project, suitable research design, etc. After having the necessary information, such buyer firms do the research on their own. Under such circumstances, the supplier research firm spends important time and money for the given task which goes waste because the issuing firm has decided to conduct the research internally. This causes immense loss to supplier research firm and hence such practices are unethical in nature and should be avoided.

   There are various obligations which are to be fulfilled by the buyer firms, e.g., facilitating the different materials which are required for the research project or conducting meetings. Supplier research firms must ensure that buyers meet these commitments in time in order to complete the contract in time. Sometimes, buyer firms violate their agreements regarding delivery of personnel or other resources in time, to which they have agreed to. Also, sometimes, buyers do not meet their payment obligations. Though it is common in many other industries, but in the research area, suppliers do not have the advantage of repossession, except through legal means.

3) **Public:** There can be events when the researcher is expected to perform the research studies on those products which could be harmful to the society. In an attempt to have a balance between the social issues and the marketing requirements, some issues may arise in the form of ethical considerations. This is quite evident in product development and advertising. **For example,** concerns have been raised by marketing researchers relating to research on advertising to children. Some advertisements aim at increasing the consumption of refined sugar by children and are aired on Sunday morning to attract children's attention. Similar concerns are raised when research is conducted on products that are considered dangerous for public like cigarettes, alcohol, sugar, etc.

   Some research firms play an active role in helping their clients implement strategy that takes into account ethical concerns. **For example,** Marketing Research firm, ABACO, based in Sao Paulo, Brazil, considers ethical aspect while evaluating their clients' promotional materials. Their AD-VISOR service provides ethical scores and makes a comparison with standards, which enables their clients to comprehend the consumers' ethical dimension of the advertisement.

4) **Respondents:** Respondents form the "lifeblood" of the marketing research industry. Over the years, it has been observed that cooperation rates of respondents have been consistently going down and the industry is concerned about the ethical treatment of respondents. All the promises which are made with the respondents (maintaining the confidentiality about the identity of the respondents) must be kept by the marketing researchers, if they expect future cooperation from respondents. Different types of issues which are experienced by the business researches with regard to respondents are as follows:

   i) **Deception of Respondents:** During the research process, respondents may be deceived. It has been shown by **Kimmel and Smith** that deception may take place at the time of recruitment, respondents may not be told about the sponsor of the research, etc. It may take place during research process; respondents may be put to different tests than agreed to. Finally, respondents may be deceived during post-research situations, their privacy may be violated. Many authors claim that the results of deception may be severe. Deception is widely used in mystery shopping. Mystery shopping involves collection of information about the competitor by sending individuals posing as customers, with the purpose of gathering price and sales-related data from employees.

   ii) **Confidentiality and Anonymity:** Promising confidentiality or anonymity is an important way of gaining trust of the respondent. Under the provision of confidentiality, the researcher is aware of the identity of the respondent but does not disclose that identity to the client. As such, identity of the respondent is confidential piece of information that is kept secret by the researcher. This condition of anonymity enables the researcher to make a stronger appeal. The respondent remains unknown to the outside world. The researcher is not interested in knowing the background of the respondent and his sole concern is collection of information from the respondent. Ethical concerns are raised when anonymity and confidentiality promised to respondent is violated and not observed by the researcher.

   iii) **Invasions of Privacy:** Marketing research is invasive in nature. Information collected by researcher may amount to invasion of privacy of respondent to some degree. Ethical issues, besides legal, come to the forefront in matters involving invasion of respondent's privacy. Unsolicited telephone calls and spam are the two most common areas which concern the common customer a lot. Both these areas are of immense concern as marketing researchers depend heavily on telephone survey and online survey research.

      a) **Unwanted Telephone Calls:** Customers have to face a lot of unsolicited telephone calls which is mainly a sort of breach of consumer privacy from the telemarketers. This has forced consumers to put pressure on the government to regulate this practice. Under such circumstances, it is the duty of researchers to work harder to build reputation among consumers and separate themselves from telemarketers.

      b) **Spam:** When a lot of useless and unwelcome e-mails are sent to random customers, it is called spam. It comes under invasion of privacy as these e-mails are not verified by the recipient. An electronic message can be defined as spam if:

         a) There is no significance of personal identity of respondent and context of the message, as it is mutually applicable to a lot of probable respondents.

         b) No thoughtful, clear, and revocable permission is provided by the recipient to receive these kinds of mails.

         c) It appears to the recipient that these e-mails received are offering some kind of benefit to the senders.

5) **Client:** The complicated nature of research-client relationship warrants distinct attention from ethical point of view. Following are some of the ethical concerns regarding research-client relationship:
   i) **Abuse of Position:** The researcher should not be involved in taking unfair benefits from his/her research expertise or position. The researcher should earnestly try to follow all research guidelines and adopt appropriate research approach and design. In other words, the researcher must give due consideration to the time and money of the client, while conducting the research.
   ii) **Unnecessary Research:** It is the ethical duty of the researcher not to engage in unnecessary research. For example, if secondary data is adequate in meeting the data requirements of research, the researcher must not conduct primary research.
   iii) **Unqualified Research:** In some cases, the required technical expertise may not be possessed by the researcher. These limitations must be conveyed to the clients and the project must be refused.
   iv) **Disclosure of Identity:** The client has the right, under the agreement, to stop the researcher from disclosing his identity before, during, and even after the research. On the other hand, the researcher is duty-bound not to disclose any piece of information about the client to respondents, competitors, etc., until and unless the client agrees.

6) **Team Members:** Ethical treatment is also the right of both the researcher and the research firm. There are number of issues which are involved in the ethical treatment by clients. They are as follows:
   i) **Improper Solicitation:** When a proposal is submitted to a prospective client by the research firm, the researcher must be confident enough that the client is serious about employing the researcher. The client should not abuse his position by awarding the project to another research firm. It should be understood that research proposal is the property of the research firm.
   ii) **Proprietary Techniques:** It is the right of the researcher to expect that there will be no revelation of its proprietary techniques to any other research firm by the client. At the same time, without permission from the researcher, the client should not employ these techniques in future.
   iii) **Misrepresentation of Findings:** No modifications should be done in the findings of the research for the personal interest of the client, keeping the reputation of the researcher at stack. Only truth but the truth must be revealed by the client.
   iv) **Additional Request:** The client can request the researcher for facilitating the additional information at the same cost of the project. There will be some additional expense occurring to the researcher due to the additional information.

5.4.4. Subjectivity in Research

The fact that the outcomes of the research are dependent on the researcher indicates the subjectivity in research. There can be variations in the conclusions of similar interview by different researchers. Whereas, when commitment score is accompanied by survey respondent, it lends objectivity to research. This is because the number obtained through commitment score will remain the same irrespective of the researcher.

Everything is governed by the subjectivity which includes research topic, hypothesis formulation, methodology selection, and data interpretation. When it comes to qualitative methodology, the researcher is expected to showcase the values or objectivity he has brought to his research and the impact of these on the research project. Other researchers are motivated to express their sentiments about the values used by the researcher.

How does the subjectivity affect the objectivity is one of the most important issues. Two alternative pieces of explanation have been given. Many qualitative researchers try to balance subjectivity and objectivity. Subjectivity is believed to be removed by the objectivity as the later makes the researcher a passive recorder of information, not allowed to interfere. On the other hand, the chances of objectively knowing a social psychological world are negated by the subjectivity of the researcher. The world under study is defined by the values of the investigator. No one will have any discussion on the world. In fact, the value will be the one which will govern the things being observed and discussed. There can be a world beyond these values and it is quite tough to know it as it is our value which will form the insight of this world.

In qualitative methodology, subjectivism is generally regarded as an essential ingredient for research. However, this is not true. Like quantitative methodology, qualitative methodology has also objective dimension. Objectivism states that the subjectivity of researcher can make him/her see and portray the world as it truly exists. There is no denying that subjectivity can prejudice researcher's understanding and thereby prevent him/her from understanding psychological reality of the world. But, this is not necessary. In essence, recognition of subjectivity as a factor in understanding the reality, helps the researcher in determining whether subjectivity promotes or hampers his/her understanding.

5.4.5. Objectivity in Research

The goal of scientific investigation is objectivity in findings. Objectivity can be regarded as a state of mind, wherein personal prejudices, likings and partialities do not influence the collection, analysis and interpretation of data. As such, scientific investigations should be impartial towards variables like race, religion, colour, gender or personal differences.

Objectivity presumes a state of reality that is independent and can be understood. However, the idea of objectivity may be undecided, if the reality sought is not independent or cannot be understood or merely is the creation of the researcher.

In order to understand people's psychology objectively, it is necessary that the researcher must organise his subjectivity first. Concepts hypothetical in nature need to be distinctly defined so that they can be recognised unmistakeably. The correct methodology need to be applied in order to gather full and meaningful evidence that can be effectively utilised in testing the power of hypothetical concepts. It is necessary that the evidence is evaluated through systematic processes and then be compared to hypothetical concepts. This is how a researcher may accept to believe that the concepts adopted by him represent the real nature of the psychology of individuals. A number of variables affect the objectivity of the researcher like insufficient behavioural data, vague hypothetical concepts and illogical analyses. This leads to imposition of theoretical constructs on data.

Ways to Deal with Objectivity Issues in Research

Following are some of the ways for dealing with objectivity issues in research:

1) **Evaluate Sources of Bias:** Reliable and credible resources will be required by the researchers for any research paper. In order to ensure objective writing, it is very important to examine each source carefully. Carefully reading publications and scholarly articles is one of the best ways for avoiding bias. Secondly, one can look for websites having domain extensions such as ".edu,", ".gov", or ".org". It is not necessary that every website, book or journal contains reliable information. In fact, there can be some hidden agendas in some sources. This is the reason why each source should be evaluated first.

2) **Balance Position with the Opposing View(s):** A good research paper is characterised by a balance which it seeks to maintain in every argument or side. Objective writing refers to combining both the sides of the arguments and describing thoroughly those different standpoints in the researcher paper. The researcher may negate contrasting opinions with the help of documentary evidence that may show that an unbiased argument has greater strength. Apart from this, reliable details and evidences can be incorporated which support the assertions and thesis report.

3) **Use Objective Language:** Presenting the information fairly and reliably for helping others to arrive at a logical conclusion reflects the objective writing in report. Subjective languages should be avoided in order to improve objectivity and integrity of the words. **For example,** any language which has the impression of value judgement such as awesome, sarcastically or wonderful, should not be used. Overly sensitive phrasing should not be included alongwith overstating adverbs or adjectives. **For example,** words such as "really" or "very" should be avoided. At the same time, any language that portrays a particular section of people in negative light should be re-written.

4) **Avoid First-person and Second-person Pronouns:** A researcher can implement the objective writing by not using first person and second person pronouns when he or she is favouring one side of an issue in comparison to another. If there are some ideas, thoughts or conclusions that are not cited, then they will be treated as the own words of the researcher. One should use third person pronouns in the report if possible if

the researcher is not conducting a primary research and detailing it. Else some kind of biased opinion can be reflected by the use of personal comments, like "I think" or "my opinion is" in place of logical argument having some supportive arguments or proofs.

5) **Express Thoughts Explicitly:** By the expression of thoughts openly, it is possible to accomplish objective writing. Stronger the arguments and supporting proofs, greater will be the preciseness of the researcher with the information. **For example**, rather than writing "most of the population", one can write "90% of the population". By having precise writing, the objectivity and credibility can be improved.

5.4.6. Significance of Ethics in Research

Following points highlight the significance of ethics in research:

1) The objectives of research are promoted by ethics. **For example,** truth, knowledge and avoiding any mistakes.
2) The values which are required for the collective work, like accountability, fairness, trust, mutual respect are encouraged. The accountability of the researcher to the public is ensured by ethics.
3) It is helpful in forming public support in favour of research as there will be greater funding for the research projects from the public if the quality and integrity of the research are maintained.
4) Both moral and social values like human rights, social responsibility, animal welfare, etc., are promoted by it.
5) Ethics ensures that interests of individuals, groups or society are secured while conducting the research.
6) Ethics evaluates different research activities and plans for their ethical accuracy. It takes care of issues like risk management, process of informed consent and protection of confidentiality.

5.5. EXERCISE

5.5.1. Short Answer Type Questions

1) List down the characteristics of research report.
2) Write a short note on interim report.
3) Enumerate the functions of research report. .
4) What is the difference between content of chapter and table of content?
5) List down the guidelines that should be followed while writing executive summary.
6) Explain report writing.
7) What is the role of audience in report writing?
8) What are the important aspects that should be considered for report presentation?
9) Elucidate subjectivity in research.
10) Give any two ways to deal with objectivity issues in research.

5.5.2. Long Answer Type Questions

1) What do you mean by research report? Explain the types of research report.
2) What are the various contents of report? Give the importance of research report writing.
3) Discuss the format of research report in detail.
4) How title of a report is selected? Explain.
5) What is an executive summary? State the need for executive summary.
6) Enumerate the process of writing an executive summary.
7) "One of the most crucial things in a research report is to cite proper research paper references by researcher." In the view of the statement, highlight the content of reference section.
8) What are the things that play an important role while writing a draft?
9) Illustrate the precautions that need to be taken while report writing.
10) What is ethics in research? State the significance of ethics in research.
11) Discuss the ethical behaviour in research? Give the principles of ethical research.
12) Write short notes on:
    i) Sugging
    ii) Frugging

CASE STUDIES

SOLVED CASE STUDIES

Case Study 1: Levi's: Fading Jeans and Market Share

As of 2006, Levi's is a leading global apparel company, with sales in more than 110 countries. It has been a long standing company with over 150 years of being in the clothing business. While one may think this long history can only result in good things, Levi's heritage has been its worst enemy. Philip Marineau, the President and Chief Executive Officer for Levi Strauss & Co., had to work to revamp Levi's antique image and make the brand appealing to younger generations in efforts to boost its declining sales. In the last five years, Marineau saw worldwide sales drop 40 per cent, losing market share to competitors like the Gap, and trendier ones such as Calvin Klein, Tommy Hilfiger, and Diesel.

Another problem for Marineau came from store brand jeans, such as JCPenney's Arizona brand jeans or the Gap's in-house brand, which have changed their image and launched an assault on big brand names like Levi's. Theses store brand jeans, alongwith other store label jeans, now target the teenage market with "cutting edge" advertising. American trade publication Brand Strategy estimated that the brand has lost about 50 per cent of the younger consumer market share worldwide between 1999 and 2005.

To compete with these brands and maintain leadership, Levi's the market leader, is considering introducing their own line of private label jeans to capture a larger portion of the teenage market. Philip Marineau wonders, "How powerful is a national brand like Levi's compared to an in-house brand like Gap or store brand like JCPenney's Arizona jeans?

Questions:

a) **If you were Philip Marineau, what type of research would you want to conduct to help to arrive at an answer?**

One Possible Solution

In the present case the exploratory research is suitable. When the purpose of research is to gain familiarity with a phenomenon or acquire new insights into it in order to formulate a more precise problem or develop hypothesis, the exploratory studies (also known as formulative research) come in handy.

Explanatory research focuses on why questions. **For example,** it is one thing to describe the crime rate in a country, to examine trends over time or to compare the rates in different countries. It is quite a different thing to develop explanations about why the crime rate is as high as it is why some types of crime are increasing or why the rate is higher in some countries than in others.

Techniques of exploratory research studies to conduct the research are as follows:

1) **Literature Research/Study of Secondary Data:** The quickest and most economical way is to find possible hypotheses from the available literature.

2) **Depth Interview/Survey of Knowledgeable Persons or Experience Survey:** Experience survey means the survey of people who have had practical experience with the problem to be studied. These individuals can be top executives, sales managers/executives, wholesalers and retailers possessing valuable knowledge and information about the problem environment.

3) **Case Study:** It involves the comprehensive study of one, or a few, specific situations and lends itself particularly to the study of complex situations in which the interrelations of several individuals are important.

4) **Focus Groups:** Focus group studies are generally conducted to evaluate the potential of a new product idea or concept.

5) **Projective Techniques:** In projective techniques, respondents are asked to interpret the behaviour of others rather than describe their own behaviour.

6) **Two-Stage Design:** In this method, the exploration is conducted in two stages. The first stage consists of clearly defining the research problem, while the second stage comprises developing the research design.

b) Please explain how you would implement the type of research you have recommended.

One Possible Solution

Implementing the Type of Research

1) **Determining Present Status:** The first step is to gather descriptive information, which will determine, as precisely as possible, the present status of the unit under investigation. Here the investigator after knowing the problem tries to find out, nature and extent of the problem.

2) **Gathering Background Information:** Once the researcher is able to achieve an accurate description of the present situation he collects background data. Here the researcher collects information about and examines the circumstances leading to the current status. At this stage the investigator compiles a reasonable list of the possible causes of the present situation. He formulates the hypotheses about the true nature of the situation. He formulates the hypotheses about the true nature of the which appear in the datas, by using the researcher's past experiences with similar situations, and by using the knowledge of the principles of human behaviour.

3) **Testing Suggested Hypothesis:** At this step the researcher gathers specific evidences in relation to each of the hypotheses suggested from he background information just gathered. The individual's behaviour is usually determined by several factors. The researcher tries to locate the factors, which are influential and therefore, are important. He tries to eliminate those, which are not.

4) **Instituting Remedial Action:** The case studies are generally carried on to make an intensive examination of problem cases. Therefore, the researcher tries to find out how one or more of the hypothesized difficulties actually contributed to the original difficulties. This is accomplished by instituting some remedial or corrective programme and then by examining as to what effect the change has brought about.

Case Study 2: New Balance: Attaining a Balance in Marketing Strategy

Situation

The U.S. athletic footwear market is likely to grow slowly during 2006-08, characterized by good volume sales and falling prices, according to a recently published report from Mintel International. It projects annual growth of 2 per cent, before inflation, rising to $ 15.5 billion in 2008. This is due to factors such as overly complex manufacturer/ retailer relationships that sap brand loyalty and foster excessive bargain hunting, a slow growth economy, and competition from brown shoe manufacturers as the previously distinct line between athletic and brown shoes becomes blurred.

Alongside this, weak retail pricing is likely to lead to more of a two-tier market – an upscale shoe market for those most dedicated to athletic shoes (young males) and those with higher levels of discretionary income, and a mass market for the rest of the nation. One bright spot revealed by Mintel's consumer research is that respondents overwhelmingly agree that they are willing to "spend money on good sneakers".

Jim Davis, CEO of New Balance Athletic Shoe, Inc., is trying to appeal to those consumers Mintel's research is talking about. New Balance rose quickly starting in the mid-1990s to be the third-largest seller of athletic shoes. Its strategy mirrored Nike's in launching the largest possible number of shoe styles and selling primarily through specialty athletic shoe stores and sporting goods stores.

A big difference, however, was that New Balance created an upscale brand image that aimed to attract a greater number of 35- to 64-year-olds. Times are changing, however, and New Balance is learning that it must also change to keep improving its market growth and profits.

Questions:

a) New Balance would like to determine consumer preferences for its brand as compared to Nike, Reebok, and Adidas. Which scaling technique should be used?

One Possible Solution

Scaling emerged from the social sciences in an attempt to measure or order attributes with respect to quantitative attributes or traits. Scaling provides a mechanism for measuring abstract concepts. For determining consumer preference comparative scaling technique will be use which is discussed below:

A comparative scale is an ordinal or rank order scale that can also be referred to as a non-metric scale. Respondents evaluate two or more objects at one time and objects are directly compared with one another as part of the measuring process.

These techniques include:

1) **Paired Comparison Scale:** Introduced nearly 150 years ago, the method of paired comparison is perhaps the most straightforward way of presenting items for comparative judgment. With the method items are presented in pairs to one or more judges; for each pair the judge selects the item that best satisfies the specified judgment criterion. It is a highly popular technique. Respondents are asked to choose which item rates higher, according to a predetermined criterion. The requisite number of individual items demonstrates a shortcoming of the paired-comparison technique. When several comparisons are required, the technique becomes less effective and less accurate due to respondent fatigue.

2) **Rank Order Scaling:** Rank order scales are comparative scales, where the respondent is asked to rate an item in comparison with another item or a group of items against each other based on a common criterion. **For example,** a respondent may be asked to rank three motorcycle brands on attributes such as cost, mileage, style and pick-up and so on.

3) **Constant Sum Scaling:** With this ordinal level technique respondents are given a constant sum of units such as points, money, or credits and then asked to allocate them to various items. **For example,** researcher could ask a respondent to reflect on the importance of features of a product and then give them 100 points to allocate to each feature of the product based on that. If a feature is not important then the respondent can assign it zero. If one feature is twice as important as another then they can assign it twice as much. When they are done, all the points should add-upto 100.

4) **Q-sort Scaling:** This is a rank order procedure where respondents are asked to sort a given number of items or statements and classify them into a predetermined number of sets (usually 11) according to some criterion such as preference, attitude, or behavioural intent. Using cards that note an item to be ranked is the most popular and simplest method to use in the sorting process. In order to increase statistical reliability atleast 60 cards should be used and no more than 140. This is good for discriminating among a large group of items in a relatively short amount of time.

b) Discuss the role of the type of scaling technique you recommend in enabling Jim Davis to determine consumer preferences for New Balance as compared to Nike, Reebok, and Adidas and increase the market share of New Balance.

One Possible Solution

Since, it is also a comparison; hence, here also the comparative scales would be used. Comparative scaling technique is useful where priorities are not clear. It is particularly useful when we do not have objective data to base this on. It helps to set priorities where there are conflicting demands on your resources. This makes it easy to choose the most important problem to solve, or select the solution that will give the greatest advantage.

Case Study 3: MTV: The World's Most Widely Distributed TV Network

MTV Networks, which includes MTV Nickelodeon, and VHI, have earned big profits for parent Viacom. The company has used a free-flowing corporate culture and a group of power brands to grow profits by 25 per cent annually during the 1990s. As of 2006, MTV was the world's most widely distributed television network reaching more than 400 million households in 164 countries and territories.

Tom Freston, CEO of MTV, actually took MTV as a small start-up and turned it into a cultural behemoth. While MTV has become an icon all over the world, gluing millions of viewers to its programming it is constantly trying to keep up with what's popular and keep its viewers watching.

MTV is always trying to find new ways to engage its target audience, 18-24 year olds. This has not always been an easy task.

For example, the channel had fading hits like Beavis and Butthead and "The Real World". Ratings began to slip as users complained that there was no longer music on MTV.

Telephone surveys were conducted with the 18-24 year old group. The sample was selected by choosing households based on computerized random digit dialing.

If the household had 18-24 years old, one person was selected using the next birthday method. The results of this survey showed that MTV needed a makeover.

Questions:

a) **Because trends come and go, it is important for MTV to stay in touch with its audience and know their wants. Tom Freston especially wants to keep in touch with the 18-24 year olds through periodic surveys. What sampling technique would you recommend?**

One Possible Solution

In the present circumstances, the systematic sampling can be an appropriate sampling technique. It can be described as follows:

Systematic Sampling: In this form of sampling one unit is selected at random from the universe and the other units are at a specified interval from the selected unit. This method can be used when the population is finite and the units of the Universe can be arranged on the basis of any system – like alphabetical arrangement, numerical arrangement or geographical arrangement etc.

Selecting a Systematic Sample

A systematic sample can be selected from a list of universe items using a four-step procedure:

1) The first step is to determine the total number of items in the universe. Divide this figure by the desired sample size. The result is called the sampling interval.

$$\text{Sampling Interval} = \frac{\text{number of universe items}}{\text{desired sample size}}$$

2) Select a random number between 1 and the sampling interval figure. This identifies the first element on the universe list to be included in the sample.

3) Add the sampling interval to the random number selected in step (b). The total represents the second element on the universe list to be included in the sample.

4) Continue adding the sampling interval to each total to create a new total. Each new total represents another element on the universe list to be included in the sample.

b) **Discuss the role of the type of sampling technique you recommend in enabling Tom Freston to keep in touch with the target audience.**

One Possible Solution

Role of Systematic Random Sampling

1) Systematic random sampling is free of classification error, and it requires minimum advance knowledge of the population other than the frame. Its simplicity also makes it relatively easy to interpret data collected via SRS.

2) It best suits situations where not much information is available about the population and data collection can be efficiently conducted on randomly distributed items, or where the cost of sampling is small enough to make efficiency less important than simplicity. If these conditions are not true, stratified sampling or cluster sampling may be a better choice.

3) Systematic sampling is easier to implement – a starting point is chosen and then a sample membe selected at fixed intervals. In selecting a sample of size 100 from a population of size 6000, we would se a random number between 1 and 60 for a start point, and then choose every 60th item until we achieve desired sample size of 100. The choice of 60 is made because the population is 60 times larger than sample size.

4) It provides a better random distribution than simple random sample.

5) With ordered list, the variance in systematic sampling may be smaller than simple random sample.

Case Study 4: Seasonal Sales of a Company

A company appoints four salesmen A, B, C and D observes their sales in three seasons – Summer, Winter a Monsoon. The figures (in lac of ₹) are given in the following table:

Seasons	Salesman			
	A	B	C	D
Summer	45	40	38	37
Winter	43	41	45	38
Monsoon	39	39	41	41

Carry out analysis of variance.

One Possible Solution

Let us take the null hypothesis that there is no significant difference between the sales of salesmen and that seasons. The above data are classified according to criteria:

1) Salesman, and
2) Season.

In order to simplify calculations, we code the data by subtracting 40 from each figure. The data in the code form are given below:

Season	Salesman				Seasons Total
	A	B	C	D	
Summer	+5	0	–2	– 3	0
Winter	+ 3	–1	+5	– 2	5
Monsoon	–1	–1	+1	+1	0
	7	– 2	4	– 4	Grand Total T = 5

Correction Factor = $\frac{T^2}{N} = \frac{(5)^2}{12} = \frac{25}{12}$ (number of observations or N is 12)

Sum of Squares between Columns (Salesmen)

This will be obtained by squaring the salesmen totals, dividing each total by the number of observations included in it, adding these figures and then subtracting the correction factor from them. Thus, sum of squares between salesmen is:

$$= \frac{(7)^2}{3} + \frac{(-2)^2}{3} + \frac{(4)^2}{3} + \frac{(-4)^2}{3} - \frac{T^2}{N}$$

$$= \frac{49}{3} + \frac{4}{3} + \frac{16}{3} + \frac{16}{3} - \frac{25}{12} = 26.25$$

Degrees of Freedom (v) = (4 – 1) = 3

Sum of Squares between Rows (Seasons)

This will be obtained by dividing the squares of the season totals by the number of observations that make-up each total, adding all such figures and subtracting these from the correction factor. Thus, sum of squares between seasons is:

$$= \frac{(0)^2}{4} + \frac{(5)^2}{4} + \frac{(0)^2}{4} - \frac{T^2}{N} = \frac{25}{4} - \frac{25}{12} = 8.33$$

Degrees of Freedom (v) = (3 – 1) = 2

Total Sum of Squares

This will be obtained by adding the squares of all the observations in the table and subtracting the correction factor there from. Thus, total sum of squares is:

Season	Salesman				Seasons Total
	A	B	C	D	
Summer	+5	0	–2	– 3	0
Winter	+ 3	–1	+5	– 2	5
Monsoon	–1	–1	+1	+1	0
	7	– 2	4	– 4	Grand Total T = 5

$$= (5)^2 + (3)^2 + (-1)^2 + (0)^2 + (-1)^2 + (-1)^2 + (-2)^2 + (5)^2 + (1)^2 + (-3)^2 + (-2)^2 + (1)^2 - \frac{T^2}{N}$$

$$= 25 + 9 + 1 + 1 + 1 + 4 + 25 + 1 + 9 + 4 + 1 - \frac{25}{12}$$

$$= 81 - \frac{25}{12} = \frac{972 - 25}{12} = 79$$

$$v = (12 - 1) = 11$$

The above information is presented in the following table:

ANOVA Table

Source of Variation	Sum of Squares	d.f.	Mean Square
Between columns (salesmen)	26.25	3	8.75
Between rows (seasons)	8.33	2	4.16
Residual	44.42	6	7.4
Total	**79**	**11**	

To test the hypothesis that there is no significant difference between the sales of salesmen and of seasons or, in other words, the three independent estimates of variance are the estimates of variance of a common population.

Now, first compare the salesmen variance estimate with the residual variance estimate, thus:

$$F_{(\text{Betwen Salesman})} = \frac{8.75}{7.4} = 1.18$$

The table value of F for 3 and 6 degrees of freedom at 5% level of significance is 4.76. The calculated value is less than this and we conclude that the sales of salesmen do not differ significantly.

Now, let us compare the season variance estimate with the residual variance estimate, thus:

$$F_{(\text{Between Seasons})} = \frac{4.16}{7.4} = 0.562$$

The critical value of F for 2 and 6 degrees of freedom at 5% level of significance is 5.14. The calculated value is less than this and hence there is no significant difference in the seasons as far as the sales are concerned.

Thus, the test shows that the salesmen and the seasons are alike so far as the sales are concerned.

Case Study 5: Testing of Drugs

Two types of drugs were used on 5 and 7 patients for reducing their weight. The decrease in the weight after using the drugs for six months was as follows:

Drug A	10	12	13	11	14		
Drug B	8	9	12	14	15	10	9

Is there a significant difference in the efficacy of the two drugs at 5% level of significance? ($t_{0.05} = 2.223$ at d.f. 10)

One Possible Solution

Let us take the hypothesis that there is no significant difference in the efficacy of two drugs, i.e., H_0: $\mu_1 = \mu_2$ and H_1: $\mu_1 \neq \mu_2$ ($\Rightarrow$ Two tailed test).

X_1	$\bar{X}_1 = 12$	$(X_1 - \bar{X}_1)^2$	X_2	$\bar{X}_2 - 11$	$(X_2 - \bar{X}_2)^2$
10	−2	4	8	−3	9
12	0	0	9	−2	4
13	+1	1	12	+1	1
11	−1	1	14	+3	9
14	+2	4	15	+4	16
			10	−1	1
			9	+2	4
$\Sigma X_1 = 60$ $n_1 = 5$		$\Sigma(X_1 - \bar{X}_1)^2 = 10$	$\Sigma X_2 = 77$ $n_2 = 7$		$\Sigma(X_2 - \bar{X}_2)^2 = 44$

$$\bar{X}_1 = \frac{\Sigma X_1}{n_1} = \frac{60}{5} = 12 \qquad \bar{X}_2 = \frac{\Sigma X_2}{n_2} = \frac{77}{7} = 11$$

$$S = \sqrt{\frac{\Sigma(X_1 - \bar{X}_1)^2 + \Sigma(X_2 - \bar{X}_2)^2}{n_1 + n_2 - 2}} = \sqrt{\frac{10 + 44}{5 + 7 - 2}} = \sqrt{\frac{54}{10}} = \sqrt{5.4} = 2.324$$

Applying t-test:

$$t = \frac{\bar{X}_1 - \bar{X}_2}{S}\sqrt{\frac{n_1 n_2}{n_1 + n_2}} = \frac{12 - 11}{2.324}\sqrt{\frac{5 \times 7}{5 + 7}} = \frac{1 \times 1.708}{2.324} = \frac{1.708}{2.324} = 0.735$$

Degrees of freedom (v) = $n_1 + n_2 - 2 = 5 + 7 - 2 = 10$

For v = 10, $t_{0.05} = 2.228$

Since, the calculated value of t is less than the table value, we accept H_0 and conclude that there is no significant difference in the efficacy of two drugs. Since, drug B is indigenous and there is no difference in the efficacy of imported and indigenous drug, we should buy indigenous drug B.

UNSOLVED CASE STUDIES

Case Study 1: Sony India

Sony, a multinational corporation based in Tokyo, Japan, stepped into India in early 1995, in the post-liberalization period. Within a couple of months in the same year, it set-up its manufacturing unit The company makes its presence felt in India through Sony Entertain Television, Sony Music and Sony India. While the first two are comfortably placed in their niche markets, it is the third which is expected to bring in all those exciting Sony digital products.

Although the government has cleared its plans to manufacture its various products, it has not been smooth sailing for Sony India.

Sony India is facing some major problems, one of which is the emergence of a grey market for its brands. While it is targeting its sales around ₹1050 crore by the turn of the century, it has to have a better understanding of India's economic, social and political environment.

Sony India would like to develop itself as its parent company developed its business units in United States (New York), Europe (Cologne), and Asia (Singapore). Since, it is a multinational company manufacturing multi-products, it has a challenging task.

Questions:

a) Do you think research can play an important role in the development of Sony India?

b) If Sony India takes recourse to research, should it set-up "in-house" research or hire the services of marketing research agencies?

c) If the choice is in favour of marketing research agency, what factors should it consider while selecting a particular agency?

Case Study 2: Ha-Pah-Shu-Tse

Raymond Red Corn is an Osage Indian. The Ha-Pah-Shu-Tse (Osage for "red corn") restaurant in Pawhuska, Oklahoma, is the only authentic Native American restaurant in the state and one of few in the country.

The Ha-Pah-Shu-Tse restaurant opened in 1972 with a seating capacity of eight; today, after expansion, crowds of upto ninety keep RedCorn and his wife busy. They are currently marketing an Indian fry bread mix, and they are planning on increased sales for their only packaged good. Indian fry bread mix has long been a staple of the Native American diet. The bread is sweet and contains basic ingredients such as flour, shortening, and sugar.

Waltina RedCorn married into the Osage tribe forty-seven years ago and learned how to cook from two women named Grandma Baconrind and Grandma Lookout. They must have taught her well, because customers of the Ha-Pah-Shu-Tse are not content just to eat there – they often have the RedCorns mail them fry bread mix.

Raymond RedCorn finds that people who eat the unusual native dish usually request the recipe. He says, "I have not found anyone who does not like the bread". Customers are not limited to local fans of Indian food. Because the fry bread is sold or served in restaurants and stores in Oklahoma as well as at a museum, people from as far away as Europe have tried it.

According to RedCorn, "About once a week, someone from England comes in". He serves these British customers fry bread or the restaurant's "best-sellers", Indian Meat Pie or Navaho Taco, and tells them the story of fry bread and how it got him an invitation to Buckingham Palace. When he was eighteen years old, he was in London for a Boy Scout Jamboree. One evening he was frying the Indian bread when the British Boy Scout organizer approached with two young men. It was only after everyone had tasted RedCorn's culinary effort that the Prince of Wales was introduced. "The Indian delegation from Oklahoma was invited to set-up their tents on the ground at the palace and spend the weekend being entertained by the young royalty", RedCorn says.

Product

The product as it is today took several years to perfect. The RedCorns wanted a mix that would need only the addition of water. Each batch was sent to relatives and friends for judgment on the taste until everyone was convinced it was the best it could be.

The mix, consisting of Indian flour, is already distributed in Tulsa, Bartlesville, and surrounding towns under the Ha-Pah-Shu-Tse brand name. It is packaged in 2- and 5-pound silver bags with Raymond RedCorn in Osage tribal costume pictured on the front. Directions for making the fry bread are listed on the back of the package.

Research Problem

When planning the marketing for the Indian fry bread mix, student consultants working with the Small Business Administration suggested some attitude research. They felt that successfully marketing the Ha-Pah-Shu-Tse product depended on knowing what consumer reactions to Indian foods would be. They believed that if the

image of Indian foods and consumers' awareness of them were measured, RedCorn would have a better chance of marketing his product. In addition, the student consultants felt that the name Ha-Pah-Shu-Tse violated many of the requirements for a good brand name – it was not short, simple, or easy to recall, and was difficult to pronounce and spell.

Questions:

a) What marketing questions must be answered as Ha-Pah-Shu-Tse plans for expansion? How can marketing research help to answer those questions?

b) What type of attitude scale would you recommend? How would you generate a set of items (attributes) to be measured?

Case Study 3: Three-Star Hotel

A three-star hotel located in Delhi has been experiencing a decline in its occupancy during the past one year. The management has recently reviewed the problem and is seriously considering attracting business executives as also to provide adequate facilities for holding business conferences, workshops, etc. Since, this would involve some renovation of the existing building in addition to new furniture and equipment, the management wants to be cautious in undertaking such expenditure.

Since its inception several years ago, the hotel has been maintaining a complete record of its guests. When a person visits the hotel for the first time, details such as his name, age, sex, permanent address, purpose of visit and duration of stay alongwith dates are entered on a card. All subsequent visits alongwith the duration of stay are dated and recorded on the same card.

The guest file has expanded tremendously containing over 8000 cards. The management wants to make use of this readily available information alongwith any additional information necessary in this regard.

Questions:

Assuming that the management has entrusted you with this job, answer the following questions:

a) Specify the statistical universe implicit in the management's choice of the sample.

b) If a sample is to be drawn from the guest file, describe the procedure you would adopt in each of the following sample designs:
   i) Simple random sampling,
   ii) Systematic random sampling,
   iii) Stratified random sampling,
   iv) Cluster sampling.

c) Which one of these sample designs would you select and why?

d) Specify the nature of data that you would collect from the sample respondents.

Case Study 4: Production of Wheat

The following data relate to the production of wheat in thousand tonnes of three varieties, *viz.*, X_1, X_2 and X_3 on 9 plots:

	Varieties		
Plots	X_1	X_2	X_3
Y_1	10	13	4
Y_2	16	19	7
Y_3	19	22	13

Is there significant difference between varieties?

Case Study 5: Subaru of America, Inc. – A Report on Reporting

Tomohiko Ikeda, Chairman, President, and CEO of Subaru of America, Inc., knows that customer loyalty is a big part of the automotive industry today, and Subaru has long been aware of this fact. Subaru, in the past, relied heavily on the traditional, paper-based customer response surveys. Short, follow-up purchase experience surveys and service experience surveys were mailed to customers within 7 to 14 days after purchase. These

surveys entailed both multiple-choice questions and open-ended questions. The response rates from the mailings ranged from 30 to 45 per cent. After all the data were collected from the mailings, dealerships received a Subaru Owner Loyalty Indicator (SOLI) rating quarterly report. These reports provided valuable information to the dealers, but they used to receive this information only four times a year. Upon receipt of this report that contained customer complaints, it was usually too late to resolve the problems.

To address this situation, the answer for Tomohiko Ikeda was the internet, which would provide faster, more flexible service and information to dealers, field staff, and the management team. Subaru hired Data Recognition Corporation (DRC) of Minneapolis, Minnesota, to set-up the programme design and provide the ongoing service. The process begins by scanning the responses from customer survey forms using optical character recognition. Customer comments are captured and categorised. Next, all survey information is electronically added to the appropriate dealer's database using a customised programme developed by DRC. The entire process is managed by DRC; hence, Subaru may concentrate on selling cars.

The web-based reports give field managers an opportunity to see what is happening at their assigned dealerships. They can access up-to-the-minute reports on a specified dealership before meeting with the dealer. This works well because the managers are able to access this information from anywhere as long as they can tap into the internet.

Dealers are able to use the site to stay on top of where they are in terms of customer satisfaction. They can see their quality scores and check on a particular salesperson's performance. Dealers are able to take immediate action because of this new technology. This allows for better management and in the long-run, better performance from all employees. As dealers became more comfortable with the web format, they began to request more detailed and timely reports. Due to this request, Subaru has recently begun to develop a series of reports called "Just-in-Time Reports". These reports provide immediate access to current performance rankings in addition to the quarterly rankings. This has become another tool for Subaru to help to boost their sales and performance. This new technology and re-focused goals on customs measurement and loyalty will help propel Subaru forward with an advantage over lagging competition.

Questions:

a) While Subaru management finds the report very useful, the dealers have a slightly different opinion. How should the report be modified to improve its usefulness to the dealers?

b) Discuss the role of the type of report you recommend in enabling Tomohiko Ikeda to make the dealer sales effort more effective.

ANNA UNIVERSITY, CHENNAI

MBA - SECOND SEMESTER EXAMINATION, MAY/JUNE - 2014

BUSINESS RESEARCH METHODS

Time: 3 Hours **Max. Marks: 100**

Note: Answer All questions.

PART - A (10×2=20)

Ques 1) What is meant by business research?

Ans: Business Research
Refer Unit-1, Page No. 19

Ques 2) Define data, information and intelligence.

Ans: Data, Information and Intelligence
Data is the information in raw or unorganised form, such as, alphabets, numbers, or symbols that refer to, or represent, conditions, ideas, or objects. Data is limitless and present everywhere in the universe.

When data is processed, organized, structured or presented in a given context so as to make it useful, it is called **information.**

Intelligence is defined as general cognitive problem-solving skills. It is a mental ability involved in reasoning, perceiving relationships and analogies, calculating, learning quickly, etc.

Ques 3) Explain briefly about research design.

Ans: Research Design – Refer Unit-2, Page No. 44

Ques 4) Write about experimental group and control group.

Ans: Experimental Group and Control Group/Treatment and Control Group
Refer Unit-2, Page No.58

Ques 5) List out the characteristics of a good sample design.

Ans: Characteristics of a Good Sample Design/Characteristics of a Good Sample
Refer Unit-3, Page No. 112

Ques 6) Distinguish between primary data and secondary data.

Ans: Primary Data *versus* Secondary Data
Refer Unit-3, Page No. 106

Ques 7) Differentiate between multiple regression analysis and multiple discriminant analysis.

Ans: Multiple Regression Analysis
Refer Unit-4, Page No. 153

Multiple Discriminant Analysis
Refer Unit-4, Page No. 161

Ques 8) What is the difference between Type I and Type II error?

Ans: Difference between Type I and Type II Error
Refer Unit-4, Page No. 183

Ques 9) What is meant by ethical dilemma?

Ans: Ethical Dilemma
Ethical dilemmas, also known as moral dilemmas, are situations in which there is a choice to be made between two options, neither of which resolves the situation in an ethically acceptable fashion. **For example**, the advent of email in the business world surely has created new ground for moral dilemmas involving information access and privacy.

In such cases, societal and personal ethical guidelines can provide no satisfactory outcome for the chooser. Ethical dilemmas assume that the chooser will abide by societal norms, such as codes of law or religious teachings, in order to make the choice ethically impossible.

Ques 10) How do you define Interpretation?

Ans: Interpretation/Interpretation of Results
Refer Unit-5, Page No. 198

PART - B (5×16=80)

Ques 11 a) Write in detail about the factors affecting business research.

Ans: Factors Affecting Business Research
Refer Unit-1, Page No. 22

Or

Ques 11 b) Discuss the role of theory in research.

Ans: Role of Theory in Research
Refer Unit-1, Page No. 39

Ques 12 a) What is focus group interview? Write about the advantages of focus group interviews.

Ans: Focus Group Interview
Focus groups are a method of group interviewing in which the interaction between the moderator and the group, as well as the interaction between group members, serves to

elicit information and insights in response to carefully designed questions. The dynamic nature of the questions asked by the moderator and the group process produces a level of insight that is rarely derived from 'unidirectional' information collection devises such as observation, surveys and less interactional interview techniques. Methods of recording and analysing information gathered during focus groups, and strategies for collecting unbiased information have helped focus group research to gain credibility as an accurate and useful source of information collection.

One topical objective of a focus group might be a new product or product concept, a new employee motivation programme, or improved production-line organisation. The basic output of the session is a list of ideas and behavioural observations, with recommendations by the moderator. These ideas and observations are often used for later quantitative testing. In exploratory research, the qualitative data that focus groups produce may be used for enriching all levels of research questions and hypotheses and comparing the effectiveness of design options. The most common application of focus group research continues to be in the consumer arena. However, corporations are using focus group results for diverse exploratory applications.

Advantages of Focus Group Interviews

1) **Cost and Speed:** Focus groups are conducted with six to twelve people at a time, and therefore a cheaper and quicker way to reach more people, while still gathering large amounts of data.

2) **Observation:** Focus group sessions can be observed and in most cases recorded so that they can be reviewed at a later stage. This allows non-verbal communication and tone of voice to be observed.

3) **Group Interaction:** Group members can interact and therefore stimulate additional ideas and thoughts, thereby contributing to the quality of the data gathered.

4) **Creativity is Enhanced:** The social context is useful in stimulating new ideas.

5) **Controllable:** A good moderator can steer the discussion in the required direction and ensure that the important issues are covered. However the moderator must not dominate the session and restrict the flow of the respondents' thoughts and ideas.

6) **Non-Threatening Situation:** People may feel more comfortable expressing ideas in the group than during a one-on-one session with an interviewer. In other words, people may use the safety of numbers (the group) to express more deeply rooted opinions without the fear of feeling exposed as they would in a one-on-one situation.

7) **In-Depth Exploration of Topics:** Focus groups allow the moderator to explore important issues in more detail to gain greater clarity on unclear issues.

8) **To Understand Complex Behaviours and Motives:** When desired information about behaviours and motivations is more complex than a questionnaire is likely to reveal. Through a series of well-designed questions, focus groups can often get at more honest and in-depth information.

Or

Ques 12 b) Explain in detail about in-depth interviews.

Ans: In-Depth Interviews

Depth interview is a qualitative research technique that involves conducting intensive individual interviews with a small number of respondents to explore their perspectives on a particular idea, programme, or situation. **For example,** we might ask participants, staff, and others associated with a programme about their experiences and expectations related to the programme, the thoughts they have concerning programme operations, processes, and outcomes, and about any changes they perceive in themselves as a result of their involvement in the programme. Depth interviews are a useful qualitative data collection technique that can be used for a variety of purposes, including needs assessment, programme refinement, issue identification, and strategic planning. In-depth interviews are most appropriate for situations in which researcher wants to ask open-ended questions that elicit depth of information from relatively few people (as opposed to surveys, which tend to be more quantitative and are conducted with larger numbers of people). Depth interviews are excellent tools to use in planning and evaluating extension programme because they use an open-ended, discovery-oriented method, which allows the interviewer to deeply explore the respondent's feelings and perspectives on a subject.

A depth interview is defined as a set of probing questions posed one-on-one to a subject by a trained interviewer so as to gain an idea of what the subject thinks about something or why he or she behaves in a certain way. It is conducted in the respondent's home or possibly at a central interviewing location such as a mall-intercept facility, where several respondents can be interviewed in depth in a relatively short time. The objective is to obtain unrestricted comments or opinions and to ask questions that will help the marketing researcher better understand the various dimensions of these opinions as well as the reasons for them. Of primary importance is the compilation of the data into a summary report so as to identify common themes. New concepts, designs, advertising, and promotional messages can arise from this method.

The significance of depth interviews is as follows:

1) **Helps in Gaining Insights:** Greater detail and insight can be gained due to the one-on-one focus with the respondent. More time can also be spent with the respondent.

2) **Helps in Developing Relationship:** The interviewer can develop a relationship of trust with the respondent and thereby encourage more detailed and revealing information.

3) **Helps in Eliminating Effects of Peer Pressure:** The effects of peer pressure can be eliminated, which means that respondents will give their true opinions and not feel forced to conform to the opinions of the group.

4) **Easier to Schedule:** The one-on-one interview is much easier to schedule than a group interview, such as a focus group. Scheduling an interview with an individual is more flexible than trying to arrange twelve people to meet at once.

5) **Complicated Behaviour:** Researchers conduct in-depth interviews when a highly detailed (step-by-step) understanding of complicated behaviour or decision-making patterns is required.

6) **Professionals:** When trying to interview respondents who are hard to reach, such as professionals, doctors, IT managers, etc., in-depth interviews are far easier to accomplish than focus groups.

7) **Complicated Behaviour:** Although in-depth interviews are infrequently used in marketing research, they are especially effective when detailed probing is needed or there is a need for a clear understanding of complicated behaviour.

8) **Confidential, Sensitive Topics:** They are better suited for situations where respondents might be easily influenced by the group response or if the topic of discussion is personal, sensitive, or confidential (including business respondents being concerned about discussing topics in front of their competitors).

Ques 13 a) Discuss the role of direct observation as a business research method.

Ans: Role of Direct Observation as a Business Research Method

1) **Superior in Data Collection on Non-Verbal Behaviour:** When a person's opinion on a particular issue is to be assessed, survey method is definitely more useful, but when the non-verbal behaviour is to be discovered or where memory failure of the respondent is possible, observation will be more functional. It allows not the restrictive study of the individuals but their in-depth study. The unstructured observational method, being very flexible, allows the observer to concentrate on any variables that prove to be important.

2) **Intimate and Informal Relationship:** Since the observer often lives with the subjects for an extended period of time, the relationship between them is often more intimate and more informal than in a survey in which the interviewer meets the respondents for 30-40 minutes on a very formal basis. The relationship sometimes becomes primary than secondary. Being close to the subject does not necessarily mean that observer will lose objectivity in recording facts. This becomes possible only when the observer becomes emotionally attached to the subject.

3) **Diversity, Flexibility and Applicability:** Observation can take diverse forms, from informal and unstructured approaches through to tightly structured, standardised procedures and can yield associated diverse types of data, both qualitative and quantitative. Observation, therefore, is applicable in a wide range of contexts.

4) **Provision of a Permanent Record:** Much of human social behaviour that may be of interest to the researcher is highly transient. The fact that all observation entails some form of recording means that it provides a permanent record of such events or behaviour, thus allowing further analysis or subsequent comparisons across time or location to be carried-out.

5) **Complementarily with Other Approaches:** Using more than one technique of data collection through a process of triangulation is seen as highly desirable as an overarching research strategy. Therefore, strength of observation is that it can effectively complement other approaches and thus enhance the quality of evidence available to the researcher.

6) **Natural Environment:** The behaviour being observed in natural environment will not cause any bias. Observation will neither be artificial nor restrictive.

7) **Longitudinal Analysis:** In observation, the researcher is able to conduct his study over a much longer period than in the survey.

Or

Ques 13 b) Discuss the importance of sampling design.

Ans: Importance of Sampling Design/Advantages of Samplings

Refer Unit-3, Page No. 118

Ques 14 a) Write short notes on:

i) Cross tabulation

Ans: Cross Tabulation

Refer Unit-4, Page No. 139

Ques 14 a) ii) Multi-collinearity

Ans: Multi-collinearity

Multi-collinearity is the undesirable situation where the correlations among the independent variables are strong. In statistics, the occurrences of several independent variables in a multiple regression model are closely correlated to one another. Multi-collinearity can cause strange results when attempting to study how well individual independent variables contribute to an understanding of the dependent variable. In general, multi-collinearity can cause wide confidence intervals and strange P values for independent variables. Multi-collinearity misleadingly inflates the standard errors. Thus, it makes some variables statistically insignificant while they should be otherwise significant.

Ques 14 a) iii) Coefficient of variation

Ans: Coefficient of Variation
The coefficient of variation is the ratio to the standard deviation to the mean expressed in percentage and is denoted by C.V. Symbolically:

$$\text{Coefficient of variation (C.V.)} = \frac{\sigma}{\bar{X}} \times 100$$

According to Karl Pearson, "Coefficient of variation is the percentage variation in mean, standard deviation being considered as the total variation in the mean." That is it shows the relationship between the standard deviation and the arithmetic mean expressed in terms of percentage.

Ques 14 a) iv) Analysis of variance (ANOVA)

Ans: Analysis of Variance (ANOVA)
Refer Unit-4, Page No. 146

Or

Ques 14 b) What is multivariate data analysis? Classify and explain about multivariate techniques.

Ans: Multivariate Data Analysis
Refer Unit-4, Page No. 152

Classification of Multivariate Techniques/ Multivariate Statistical Techniques
Refer Unit-4, Page No. 152

Ques 15 a) Explain elaborately about research report and its format.

Ans: Research Report – Refer Unit-5, Page No. 186

Format/Structure of Research Report
Refer Unit-5, Page No. 191

Or

Ques 15 b) What precautions should be taken while preparing research report?

Ans: Precautions In Preparing/Writing the Research Report – Refer Unit-5, Page No. 208

ANNA UNIVERSITY, CHENNAI

MBA - SECOND SEMESTER EXAMINATION, APRIL/MAY - 2015

BUSINESS RESEARCH METHODS

Time: 3 Hours **Max. Marks: 100**

Note: Answer All questions.

PART – A (10×2=20)

Ques 1) Differentiate descriptive research from analytical research.

Ans: Difference between the Descriptive and Analytical Research

Basis of Difference	Descriptive Research	Analytical Research
1) Objective	Descriptive research attempts to determine, describe, or identify *what* is.	Analytical research attempts to establish *why* it is that way or how it came to be.
2) Basis	Its logic is based on the statistics of the research analysis.	Analytical study is based on facts.
3) Nature	Descriptive research describes the characteristics of the situations.	Analytical research most likely goes deep inside the information for critical evaluations of situations.

Ques 2) What is the role of theory in research?

Ans: Role of Theory in Research
Refer Unit-1, Page No. 39

Ques 3) What is content validity?

Ans: Content Validity
Refer Unit-3, Page No. 93

Ques 4) What is a rating scale?

Ans: Rating Scale
Refer Unit-2, Page No. 79

Ques 5) What is quota sampling?

Ans: Quota Sampling
Refer Unit-3, Page No. 121

Ques 6) What are the advantages of survey method?

Ans: Advantages/Significance of Survey Method
Refer Unit-3, Page No. 100

Ques 7) What is discriminant analysis?

Ans: Discriminant Analysis
Refer Unit-4, Page No. 159

Ques 8) What is MDS?

Ans: Multi-Dimensional Scaling (MDS)
Refer Unit-4, Page No. 169

Ques 9) What are the contents of executive summary?

Ans: Contents of Executive Summary/Executive Summary
Refer Unit-5, Page No. 194

Ques 10) What is referencing?

Ans: Referencing/Bibliography and References
Refer Unit-5, Page No. 200

PART – B (5×16=80)

Ques 11 a) Briefly explain the techniques involved in defining a research problem with an example.

Ans: Techniques Involved in Defining a Research Problem/Steps in Problem Definition
Refer Unit-1, Page No. 32

Or

Ques 11 b) Write down a procedure for hypothesis testing.

Ans: Procedure for Hypothesis Testing/Steps in Testing Hypothesis
Refer Unit-4, Page No. 181

Ques 12 a) Briefly explain the types of experimental designs used in business.

Ans: Types of Experimental Designs Used in Business/Types of Experimental Research Design
Refer Unit-2, Page No. 59

Or

Ques 12 b) Discuss the various types of measurement scales.

Ans: Types of Measurement Scales/ Types of Scales
Refer Unit-2, Page No. 74

Ques 13 a) Discuss the methods of data collection by big business houses in recent times.

Ans: Methods of Data Collection by Big Business Houses in Recent Times/ Methods of Primary Data Collection
Refer Unit-3, Page No. 86

Or

Ques 13 b) Describe the methods of determining sample size.

Ans: Methods of Determining Sample Size/ Determining Size of the Sample
Refer Unit-3, Page No. 114

Ques 14 a) Describe the Bivariate data analysis procedures.

Ans: Bivariate Data Analysis Procedures/Bivariate Analysis
Refer Unit-4, Page No. 138

Or

Ques 14 b) Explain the steps in cluster analysis.

Ans: Steps in Cluster Analysis
Refer Unit-4, Page No. 166

Ques 15 a) Suggest an outline of the research report that is generally accepted as the basic format for most research projects.

Ans: Outline/Format/Structure of the Research Report
Refer Unit-5, Page No. 191

Or

Ques 15 b) State the precautions in writing a research report.

Ans: Precautions in Writing a Research Report
Refer Unit-5, Page No. 208

ANNA UNIVERSITY, CHENNAI

MBA - SECOND SEMESTER EXAMINATION, MAY/JUNE-2016

BUSINESS RESEARCH METHODS

Time: 3 Hours **Max. Marks: 100**

Note: Answer All Questions.

PART – A (10×2=20)

Ques 1) What is empirical research?

Ans: Empirical Research
Refer Unit-1, Page No. 24

Ques 2) Define "Hypothesis".

Ans: Hypothesis/Research Hypothesis
Refer Unit-1, Page No. 37

Ques 3) What is a "Variable" in research?

Ans: Variable – Refer Unit-1, Page No. 42

Ques 4) Give meaning for the term "Reliability".

Ans: Reliability – Refer Unit-2, Page No. 77

Ques 5) What do you mean by secondary data?

Ans: Secondary Data
Refer Unit-3, Page No. 106

Ques 6) What is "Sampling Plan"?

Ans: Sampling Plan – Refer Unit-3, Page No. 117

Ques 7) What do you understand by "Data Coding"?

Ans: Data Coding/Coding
Refer Unit-4, Page No. 128

Ques 8) Define "Bivariate Analysis".

Ans: Bivariate Analysis
Refer Unit-4, Page No. 138

Ques 9) State the difference between subjectivity and objectivity.

Ans: Difference between Subjectivity and Objectivity
Refer Unit-5, Page No. 213-214

Ques 10) What are the different types of research reports?

Ans: Types of Research Reports/Types of Reports
Refer Unit-5, Page No. 187

PART – B (5×13=65)

Ques 11 a) Explain the meaning, source identification purpose of research questions, problems and objectives in the field of business management research.

Ans: Meaning of Research Questions
Refer Unit-1, Page No. 34

Source Identification of Research Questions/ Major Sources for Identifying Problem in Business Research
Refer Unit-1, Page No. 29

Purpose of Research Questions

1) The definition of a research question sets the direction of the study.
2) It reveals the methodology or procedure of the study.
3) It helps the researcher to control subjectivity or biases of the researcher.
4) It suggests and specifies the variables to be taken-up into the investigation through a problem involved into so many variables.
5) It makes the research work practicable.
6) It suggests the source of data and facilitates their interpretation.

Problems in the Field of Business Management Research

1) **Difficulty in Use of Social Media for the Purpose of Data Collection:** While it cannot be denied that having thorough information about the market conditions helps most market research companies in drafting the best of strategies to enter the market face the existing challenges and making a mark in the industry alongwith reaching out to consumers, most market research companies face difficulties in adapting to the latest technologies to make their mark in the virtual world.
2) **Lower Rate of Response:** On one hand though technology helps in carrying out a larger number of surveys; the hidden hurdle faced by the market research companies is waning of active participation by respondents resulting in lower responses. Though the consumers might have many things to say about the products or services, the simple fact that they have to take part in so many surveys being carried out might make many of them shy away from participating in the same. These results in carrying out only sample surveys of only those select few people who show eagerness in participating in the surveys without real participation of a large number of people.

Objectives in the Field of Business Management Research/Objectives of Business Research

Refer Unit-1, Page No. 20

Or

Ques 11 b) Mention and discuss various types of research with suitable examples from the business management point of view.

Ans: Types of Research

Refer Unit-1, Page No. 23

Ques 12 a) Illustrate the research design process, types and benefits in the context of any functional management research.

Ans: Research Design Process

Refer Unit-2, Page No. 46

Types of Research Design

Refer Unit-2, Page No. 47

Benefits of Research Design in any Functional Management Research/Significance of Research Design

Refer Unit-2, Page No. 45

Or

Ques 12 b) Explain the step by step course of action of construction a research scale and give an outline of a scale on a title of your choice.

Ans: Steps in Research Scale Construction/Process of Scale Construction

Refer Unit-2, Page No. 72

Scale for Determining the Popularity of the Hero Motorcycles

In order to determine the popularity of the Hero Motors in two-wheeler section, following Likert scale is prepared:

1) Strongly disagree,
2) Disagree,
3) Neither agree nor disagree,
4) Agree,
5) Strongly agree,

Ques 13 a) List out the different methods of primary data collection to carry out a business research and explain the purpose of every method.

Ans: Methods of Primary Data Collection

Refer Unit-3, Page No. 86

Or

Ques 13 b) Differentiate probability method of sampling from that of non-probability method of sampling providing examples for each.

Ans: Difference between Probability and Non-probability Method of Sampling

Refer Unit-3, Page No. 122

Ques 14 a) Discuss about measures of central tendency and how they are useful in any business research work?

Ans: Measures of Central Tendency

Measure of central tendency is also known as 'measure of central value' or 'measure of location' or 'average of first order'. It is a statistical measure and calculates the location or position of central point to explain the central tendency of the whole quantity of data.

According to Simpson and Kafka, "A measure of location is a typical value around which other figures congregate."

Properties of Good Measures of Central Tendency

1) It should be rigidly defined.
2) Its definition should be in the form of a mathematical formula.
3) It should be easy to understand and calculate.
4) It should remain unaffected by the extreme values.
5) It should be capable of further algebraic treatment.
6) It should be based on all items in the series.
7) It should be capable of being used in further statistical computation or processing.
8) It should possess sampling stability.

Use of Measures of Central Tendency in Business Research Work

1) Collected and classified figures are vast. To condense these figures we use average. Average converts the whole set of figures into just one figure and thus helps in condensation.

2) Measures of central tendency or averages give us one value for the distribution and this value represents the entire distribution. In this way averages convert a group of figures into one value. Average value provides a clear picture about the field under study for guidance and necessary conclusion.

3) It gives a concise description of the performance of the group as a whole and it enables us to compare two or more groups in terms of typical performance. To make comparisons of two or more than two distributions, we have to find the representative values of these distributions. These representative values are found with the help of measures of the central tendency.

4) Many techniques of statistical analysis like Measures of Dispersion, Measures of Skewness, Measures of Correlation, and Index Numbers are based on measures of central tendency. That is why, measures of central tendency are also called as measures of the first order.

Or

Ques 14 b) Explain the objective, process and application of multiple regression and correlation analysis to solve business research problems.

Ans: Objective of Multiple Regression
Refer Unit-4, Page No. 154

Process of Multiple Regression/ Steps in Multiple Regression
Refer Unit-4, Page No. 154

Application of Multiple Regression
Refer Unit-4, Page No. 157

Objective of Multiple Correlation Analysis
Refer Unit-4, Page No. 158

Process/ Methods of Calculation of Multiple Correlation Analysis
Refer Unit-4, Page No. 158

Application of Multiple Correlation Analysis
Refer Unit-4, Page No. 159

Ques 15 a) Describe the process of report preparation. Discuss the importance of objectivity in writing a Marketing/Finance/Human Resource research report.

Ans: Process of Report Preparation/Process of Writing Research Reports
Refer Unit-5, Page No. 201

Importance of Objectivity in Writing Marketing, Finance and Human Resource Research Report/ Objectivity in Research
Refer Unit-5, Page No. 214

Or

Ques 15 b) Discuss the importance of language, cauterisation, tone, and proof reading in a research report preparation.

Ans: Research Report Preparation

1) **Importance of Language:** Research writing is designed to convey information of a precise nature. Avoid ambiguity, multiple meanings, and allusions. Take care to choose the right words – words that convey thoughts accurately, clearly, and efficiently. When concepts and constructs are used, they must be defined, either operationally or descriptively. Words and sentences should be carefully organized and edited. Misplaced modifiers run rampant in carelessly written reports. Subordinate ideas mixed with major ideas make the report confusing to readers, forcing them to sort out what is important and what is secondary when this should have been done for them.

2) **Importance of Cauterisation:** On the one hand, a written report should be complete in the sense that it stands by itself and that no additional clarification is needed. On the other hand, the report must be concise and must focus on the critical elements of the project and must exclude unimportant issues. There is a great temptation, on the part of inexperienced researchers, to seek to convey all that they did in order to obtain information and to complete the research. This is done almost as if the researcher is afraid that the audience will not otherwise appreciate the time, effort and intellectual difficulties involved. What the researcher has to come to realise is that he/she will be judged by the contribution towards solving the marketing problem and not by the elegance or effort involved in the research methodology.

3) **Importance of Tone/Tone:** Refer Unit-5, Page No. 205

4) **Importance of Proofreading/Final Proof:** Refer Unit-5, Page No. 206

PART – C (1×15=15)

Ques 16 a) Prepare a research proposal in detail for a research problem of your business area of interest.

Ans: Research Proposal for Determining the Percentage of Supporters of Lokpal Bill

1) **Problem Statement:** A research to determine the percentage of supporters of Lokpal Bill in New Delhi.

2) **Research Objective:** To find the number of Lokpal Bill supporters in New Delhi.

3) **Research Design:** Exploratory research design is used to explore the supporters of Lokpal Bill.

4) **Work Schedule:** For literature review two to three days are taken. One day is assigned for questionnaire preparation. In order to collect the data one week is assigned. Data analysis and report preparation is given another one week.

5) **Budget:** In order to conduct the micro level research in major sectors of New Delhi approximately fifty thousand rupees is required.

Or

Ques 16 b) In order to prove the importance of Chi square analysis, correlation analysis and two sample t test analysis create tables with imaginary and appropriate values and explain the results.

Ans: Importance of Chi Square Analysis
A manager of a hotel believes that the standard deviation of people using the luxury room is greater than seven. A random sample of 15 days is selected and the data is given below. Is there enough evidence to support the manger's claim? Test at $\alpha = 0.10$. Assume the variable is normally distributed.

25	42	12	30	16	38	5	9	8	15
10	14	18	12	27					

Step 1: State the hypothesis and identify the claim.
We have the standard deviation. We have to square it to get the variance.

$H_0: \sigma^2 \leq 49$

$H_a: \sigma^2 > 49$ (claim)

Step 2: Find the critical value.
We have a right-tailed test with degrees of freedom of 15 – 1 = 14. Using the table, with $\alpha = 0.10$, we find the critical value is 21.064.

Step 3: Compute the test value.
Let the assumed mean (A) = 15.

Calculation of Standard Deviations

X	f	$d_x = (X - A)$	d_x^2	fd_x	fd_x^2
5	1	–10	100	–10	100
8	1	–7	49	–7	49
9	1	–6	36	–6	36
10	1	–5	25	–5	25
12	2	–3	9	–6	18
14	1	–1	1	–1	1
15	1	0	0	0	0
16	1	1	1	1	1
18	1	3	9	3	9
25	1	10	100	10	100
27	1	12	144	12	144
30	1	15	225	15	225
38	1	23	529	23	529
42	1	27	729	27	729
Total	**$\Sigma f = 15$**			**$\Sigma fd_x = 56$**	**$\Sigma fd_x^2 = 1966$**

$$s = \sqrt{\frac{\sum f(d_x)^2}{\sum f} - \left(\frac{\sum fd_x}{\sum f}\right)} = \sqrt{\frac{1966}{15} - \left(\frac{56}{15}\right)^2}$$

$$= \sqrt{131.1 - 14} = 10.82$$

Substituting the values in the formula, we have:

$$\chi^2 = \frac{(n-1)s^2}{\sigma^2} = \frac{(15-1)(10.8)^2}{49} = 33.3$$

Step 4: Make the decision.
The test value 33.3 is greater than the critical value 21.064, and it falls in the critical region.
The decision is to reject the null hypothesis.

Step 5: Summarise the results.
There is enough evidence to support the manager's claim that the standard deviation is greater than 7.

Importance of Correlation Analysis/ Types of Correlation
Unit-5, Page No. 140

Importance of Two Sample t-Test
In a mutation breeding experiment, gamma-irradiation effect was evaluated on 200 seed weight in grams per plant of a mungbean variety in M_2 generation. The experimenter obtained the following results.

Analyse the data using the t-test and give your inference as regards the effect of gamma-irradiation.

200-Seed Weight (Grams) per Plant

Control	2.9	3.2	3.5	3.4	3.1	4.0	3.8	3.0	4.1	4.0
Treated	2.9	2.8	3.0	3.5	3.7	3.3	3.0	3.1	2.9	2.8

Null Hypothesis: Ho: There is no significant difference between the mean 10 seed weight per plant in the control and treatment.

200-Seed Weight (Grams)

Control		Treated	
x_1	$(x_1)^2$	x_2	$(x_2)^2$
2.9	8.41	2.9	8.41
3.2	10.24	2.8	7.84
3.5	12.25	3.0	9
3.4	11.56	3.5	12.25
3.1	9.61	3.7	13.69
4.0	16	3.3	10.89
3.8	14.44	3.0	9
3.0	9	3.1	9.61
4.1	16.81	2.9	8.41
4.0	16	2.8	7.84
35	**124.32**	**31**	**96.94**

$$\bar{x}_1 = \frac{\Sigma x_1}{n_1} = \frac{35}{10} = 3.5 \qquad \bar{x}_2 = \frac{\Sigma x_2}{n_2} = \frac{31}{10} = 3.1$$

$$\Sigma x_1^2 - \frac{(\Sigma x_1)^2}{n_1} = 124.32 - \frac{(35)^2}{10} = 124.32 - 122.5 = 1.82$$

$$\Sigma x_2^2 - \frac{(\Sigma x_2)^2}{n_2} = 96.94 - \frac{(31)^2}{10} = 96.94 - 96.1 = 0.84$$

Degrees of freedom, d.f. = $(n_1 + n_2 - 2)$
$= (10 + 10 - 2) = 18$

Pooled variance, $s_1^2 = \frac{1.82 + 0.84}{18} = \frac{2.66}{18} = 0.147$

Pooled standard deviation, $s_d = \sqrt{s_d^2} = \sqrt{0.147} = 0.38$

$$\therefore t = \frac{|\bar{x}_1 - \bar{x}_2|}{s_d\sqrt{\frac{1}{n_1} + \frac{1}{n_2}}} = \frac{|3.5 - 3.1|}{0.38\sqrt{\frac{1}{10} + \frac{1}{10}}} = \frac{0.4}{0.38\sqrt{\frac{1}{5}}}$$

$$= \frac{0.4}{0.38 \times 0.45} = \frac{0.4}{0.17} = 2.35$$

Conclusion:
Calculated t value = 2.35
Tabulated t value = 2.10 (p = 0.01)
d.f. = 18

The calculated 't' value for the difference of the two sample means is greater than the tabulated 't' value at 5 % level of probability with 18 d.f. The difference between the two sample means is significant. The null hypothesis stating that the two sample means are not different is rejected at $p < 0.05$. Therefore, gamma-irradiation has a very significant effect on 200 seed weight.

ANNA UNIVERSITY, CHENNAI

MBA - SECOND SEMESTER EXAMINATION, APRIL/MAY-2017

BUSINESS RESEARCH METHODS

Time: 3 Hours **Max. Marks: 100**

Note: Answer All questions.

PART - A (10×2=20)

Ques 1) How would you describe the research process?

Ans: Research Process – Refer Unit-1, Page No. 12

Ques 2) What is the purpose of a literature survey?

Ans: Purpose of a Literature Survey/Literature Survey
Refer Unit-1, Page No. 13

Ques 3) List the significance of research design.

Ans: Significance of Research Design
Refer Unit-2, Page No. 43

Ques 4) List any two demerits of experimental and control groups?

Ans: Demerits of Experimental Groups and Control Groups

1) The responses of the participants may be influenced by many factors in the surrounding. Instead of giving genuine responses, the respondents may respondent what the researcher wants to hear or may modify the response as per the subject of research.
2) The responses given by the respondents in such designs are uncertain as it is difficult to differentiate between the true and manipulated responses.

Ques 5) Enumerate the different methods of collection of data.

Ans: Methods of Collection of Data
Refer Unit-3, Page No. 84

Ques 6) State any two problems faced in collection of data through schedules?

Ans: Problems Faced in Collection of Data through Schedules

1) It requires trained enumerators, which are not easily available.
2) The personal bias of enumerator may lead to wrong conclusions.

Ques 7) What do you mean by one-tailed test and two-tailed test?

Ans: One-Tailed Test and Two-Tailed Test
Refer Unit-4, Page No. 184

Ques 8) Explain briefly about acceptance region and rejection region.

Ans: Acceptance Region and Rejection Region
Refer Unit-4, Page No. 180

Ques 9) What is research proposal?

Ans: Research Proposal
When a dissertation (or thesis) is represented in a short and precise form, it is known as a research proposal. It is the blueprint of research study, which depicts the main aspects of the research in the form of a research design.

A researcher deliberately prepares a research proposal so as to represent the aims and objectives of his research study to the authorities. Its main objective is to prove the committee that the researcher has performed a useful research study, which will significantly update present banks of educational knowledge.

Research proposal is a written description of the fundamental plan for any research project. It explains the reason that why specific issues have to be resolved and what suitable research design should be chosen in order to examine them.

It explains the why, what, where, when and at what cost is the researcher going to undertake a research project. When a researcher performs a qualitative research, the research proposal is of flexible nature as the techniques involved in the research tend to develop and evolve.

Ques 10) What should be the part of executive summary?

Ans: Executive Summary
Refer Unit-5, Page No. 194

PART - B (5×13=65)

Ques 11 a) Is there an advantage in stating the hypothesis both in the null and in the alternate? Justify your answer with an example.

Ans: Yes, there is an advantage in stating the hypothesis both in the null and in the alternate because they add clarity to our thinking about what we are testing.

A null hypothesis is formulated so that it can be tested for possible rejection. If we reject a null hypothesis, then all permissible alternative hypotheses relating to the particular relationship tested could be supported.

A null hypothesis is a statement that there is no actual relationship between variables. It states the opposite of what the experimenter would expect or predict.

Alternative hypothesis states a potential outcome that the researcher may expect. It comes from prior studies and it is established when a null hypothesis is rejected. Most often, an alternative hypothesis is the desired conclusion of the experimenter.

A non-directional alternative hypothesis states that the null hypothesis is wrong. A non-directional alternative hypothesis does not predict whether the parameter of interest is larger or smaller than the reference value specified in the null hypothesis.

A directional alternative hypothesis states that the null hypothesis is wrong, and also specifies whether the true value of the parameter is greater than or less than the reference value specified in null hypothesis.

For example, not so long ago, people believed that the world was flat.

Null hypothesis, H_0: The world is flat.

Alternate hypothesis H_1: The world is round.

Several scientists, including Copernicus, set out to disprove the null hypothesis. This eventually led to the rejection of the null and the acceptance of the alternate. Most people accepted it — the ones that did not created the Flat Earth Society. What would have happened if Copernicus had not disproved it and merely proved the alternate? No one would have listened to him. In order to change people's thinking, he first had to prove that their thinking was wrong.

Therefore, simultaneously stating and testing both null and alternative hypothesis becomes important, as merely testing any one of them will not give any surety if the other side of it will occur or not.

Or

Ques 11 b) "Research is much concerned with proper fact finding, analysis and evaluation". Do you agree with this statement? Give reasons in support of your answer.

Ans: Yes, research is about finding facts, analysing them and then evaluating the results. Research comprises of two words, "Re" and "search". While "Re" implies a repetitive or iterative process, "Search" denotes making a thorough examination of or looking over carefully in order to find something. Research aims at adding to the existing stock of knowledge for the betterment of world.

According to Clifford Woody, "Research comprises defining and redefining problems, formulating hypothesis or suggested solutions, Collecting, Organising and Evaluating data, Making deductions and reaching Conclusions to determine they fit the formulating hypothesis".

Reasons for Support

1) Research involves scientific and systematic analysis of a research area as well as concluding the findings with appropriate reasoning. It is a systematic as well as an object-oriented process. The process of research begins with identifying the research problem; following data collection, data analysis, and ends with conclude the findings. It should be conducted in an unbiased manner, without manipulating the findings.

2) One of the prime objectives of research is to explore the unknown object or phenomenon. While exploring, a researcher tries to understand the details of the situation or phenomenon for developing preliminary hypotheses and generalisations. Exploring allows the researchers to develop theories and explains the questions of how and why a phenomenon operates in a particular way.

3) After the research problem is formulated, data collection is performed systematically. Without having accurate data about the research problem, it is not possible to complete a study as it works as a source of information helpful in getting the solution. The data collected is analysed and used for either supporting or replacing the philosophies presented by earlier related researches. Data collection plays a crucial role in combining the theories with their practical applications.

4) Data analysis is very essential to draw-out the required information from the raw data by making it organised and meaningful. Organising and analysing the data facilitates the researchers to understand the feature of sample. Though data

collection provides a lot of raw data, but these data are unorganised in nature. By analysing the data, data are organised in such a manner that it provides meaningful answers. **For example**, responses of a survey may be compared to know the number of individuals attending the survey as well as the approaches used by respondents to answer certain questions.

5) After analysing the data, researchers try to interpret the findings on the basis of theoretical and practical objectives of research. Data interpretation is a step of research process where the measurements and statistical observations of the study are scrutinised to develop evidences for responding to a research problem.

Ques 12 a) Whenever possible, it is advisable to use instruments that have already been developed and repeatedly used in published studies, rather than develop our own instruments for our studies. Do you agree? Discuss the reasons for your answer.

Ans: It is always advisable to use well-validated instruments that have been repeatedly used in published studies, rather than going through the cumbersome process of developing one's own instruments and laboriously establishing their validity and reliability.

However, simply because an instrument is used in some published studies does not necessarily make it a good instrument. It is always wise to examine the psychometric properties established for the instrument before using it. In case this is not easily available, a pilot study can be conducted to see if the measures have at least acceptable reliability. Practicality is also a criterion for testing the measuring instrument. The extent, to which a particular measuring instrument is suitable, cost-effective and interpretable, denotes the practicality of the instrument.

The next criterion for evaluating the measurement instrument is its sensitivity. A particular measuring instrument is said to be sensitive if all the variations in responses or stimuli are effectively measured by it. Measuring instruments dealing with 'Agree' or 'Disagree' types of responses are not so sensitive. A little modification is required in instruments so as to record more sensitive responses.

Validity is the most important criterion and measures the degree to which the instrument measures what it is required to measure. It can also be considered as the utility of the instrument. It measures the extent to which the differences in the test measurements reflect the actual differences. **For example**, if a researcher is trying to examine the motivation level of employees, then he needs to look into a variety of other factors as well. Say, if he considers only absenteeism, then it is not a valid measure as absenteeism may also happen due to other causes like illness, personal reasons, family reasons, etc.

Reliability is all about the precision and the accuracy of the measuring instrument. In other words, the result of the measuring instrument is reproducible or replicable. Reliability of a measuring instrument means that it produces consistently the same or similar results over different time periods and in different conditions. **For example**, if a thermometer measures the temperature of a city to be similar or same every time, then the thermometer is considered to be reliable. In other words, reliability is the ability of a measuring instrument to provide consistent results over time without error.

Or

Ques 12 b) Explain the concept of "trade-off between internal validity and external validity".

Ans: Trade-Off between Internal Validity and External Validity

Refer Unit-2, Page No. 65

Ques 13 a) "Every data collection method has its own built-in biases. Therefore, resorting to in multi-methods of data collection is only going to compound the biases". How would you critique this statement?

Ans: It is true that most data collection methods in research have their own built-in biases. **For example,** the basis of information acquired in the interview is the words of respondents instead of their actions, as there may be disparities between the two. What the people are saying that they do, favour or believe; can be another way true. Specifically, the personality of the interviewer can influence the words of the interviewee. However, such problems can be overcome in the case of the online interviews when the verbal and visual hints are missing.

The questionnaire is a one-time data collection process. Once the respondent has given his answers, it is often very difficult for him/her to give a fresh perspective. Rarely any researcher goes to the participants for the confirmation of responses. Thus, there is no assurance that the responses are appropriate. This leads to the possibility of invalid responses.

But when data are collected through multiple methods and compared, if the correlations among the several types of responses received through the different data collection methods are high, we can be fairly confident that the data have good validity and reliability – i.e. they are "good". If the correlations are low, however,

we would start wondering about the goodness of our data. We would then pay closer attention to the methods used. **For example,** if respondents say that they experience a high level of meaningfulness in their jobs when they are interviewed, and when the concept is measured through several items in the questionnaire, we would be inclined to treat these as acceptable data even though both may have a low correlation to data obtained from a sentence completion motivational research. If, however, there is no correlation at all among any of the methods, the goodness of the data collected will be highly suspect.

Though, individual methods of data collection have respective biases, it is possible that multi-methods may lead to increased biases. Researchers are bound to use multi-sources or multi-methods due to complex nature of the research. Therefore, they should be ready with counter strategies so as to deal with such situations.

Or

Ques 13 b) Explain the principles of wording, stating how these are important in questionnaire design, citing a few examples.

Ans: Principles of Wording

1) **Content and Purpose of Questions:** All questionnaire items should be directly related to the objectives and uses of the survey. Only those questionnaire items for which responses can be provided easily and with sufficient reliability should be included.

2) **Language and Wording of Questions:** As the type of questions to be used in questionnaire is determined, researcher now concentrates on the wording and phrasing of the questions. The questions should be very simple and unambiguous. No confusing or sentimental words should be used. Easier the words are used, more it becomes effective. Any inappropriate word or phrase may hinder the relevant answers of the respondents. The wording of a questionnaire should be framed keeping in mind important factors like, language, education, research purpose, etc. **For example,** if the target segment comprises uneducated/low educated respondents, then a questionnaire which is full of research jargons will fail.

3) **Type and Form of Questions:** After selecting the types of questionnaire to be used for collecting data, the next step is to determine the content of each question. It is very critical for the researcher as it encourage the respondent to give their genuine responses. The type of questions to be used generally depends on the type of questionnaire to be used as well as the purpose of research. **For example,** if the research purpose is to know the opinion of people regarding gender biasness, and the questionnaire is unstructured and disguised, the questions should be such as:
   i) Do you have brother or sister? Yes____ No____
   ii) If yes, then how many? No. of brothers_____ No. of sisters_____
   iii) In which kind of school have you completed your education? Co-ed_____ Girls/Boys school____

4) **Sequence of the Questions:** After finalising the wording or phrasing of the questions, next step is arranging the questions in most appropriate and effective way. A questionnaire has many parts – basic data, classification data and identification data. There should be a flow in which the questions should be asked. The sequence of questions is very important for a questionnaire to be effective. Hence, significant efforts should be put by the researchers in arranging the questions in an order that can prove to be helpful in getting the responses.

5) **Classification Data:** Classification data, also known as personal information or demographic questions, elicit such information as age, educational level, marital status, and income. Unless absolutely necessary, it is best not to ask for the name of the respondent.

Ques 14 a) "The procedure of testing hypothesis requires a researcher to adopt several steps." Describe in brief all such steps.

Ans: Steps in Testing Hypothesis

Refer Unit-4, Page No. 183

Or

Ques 14 b) What is the significance of using multiple discriminant analysis? Explain the technical details involved in such a technique.

Ans: Significance of Using Multiple Discriminant Analysis

The primary importance of multiple discriminant analysis is the study of relationships among several groups in terms of multiple measurements. This provides a basis for classification of individuals among the several groups. The approach provides tests of significance for certain important hypotheses for relationships among several groups; e.g., a single composite score accounts for all significant differences among the groups.

Technical Details of Multiple Discriminant Analysis

Refer Unit-4, Page No. 161

Ques 15 a) How have technological advancements helped in writing and presenting research reports? Why is it necessary to specify the limitations of the study in the research report?

Ans: Role of Technological Advancements in Writing and Presenting Research Reports
Several technological advances have greatly improved report writing. There are several software tools now available to help researchers gain efficiency in report writing.

Different errors in report writing can be eliminated through use of grammar check software, appropriate words of group of words can be used with the help of online dictionary, tables and charts can be automatically drawn and inserted in the report, etc. Use of graphics and animation software can be helpful in report presentation. PowerPoint presentation is also a kind of software which can be used to present the report.

Necessity of Specifying the Limitations of the Study in the Research Report/Limitations of the Study
Refer Unit-5, Page No. 200

Or

Ques 15 b) Write short notes on the following:
i) Characteristics of a good research report.

Ans: Characteristics of a Good Research Report
Refer Unit-5, Page No. 186

Ques 15 b) ii) Bibliography and its importance in context of research report.

Ans: Bibliography and its Importance/Bibliography and References
Refer Unit-5, Page No. 200

PART - C (1×15=15)

Ques 16) A tax consultant wonders whether he should be more selective about the class of clients he serves so as to maximise his income. He usually deals with four categories of clients – the very rich, rich, upper middle class, and middle class. He has records of each and every client served, the taxes paid by them, and how much he has charged them. Since many particulars in respect of the clients vary (number of dependents, business, deductibles, etc.), irrespective of the category they belong to, he would like an appropriate analysis to be done to see which among the four categories of clients he should choose to continue to serve in future. What kind of analysis should be done in the above case and why? Justify.

Ans: Since the objective of the tax consultant is to maximize his/her income, he/she should start with the historical analysis of each category of his customer.

He/she uses the multiple linear regression analysis, because he/she can analyse the variation of the various factors which vary widely. With the multiple linear regression test he/she can calculate the most influential variable.

If he/she can represent the influential value from β then tax consultant chooses the variable with the largest β.

ANNA UNIVERSITY, CHENNAI

MBA - SECOND SEMESTER EXAMINATION, APRIL/MAY-2018

BUSINESS RESEARCH METHODS

Time: 3 Hours **Max. Marks: 100**

Note: Answer All questions

Part-A **(10×2=20)**

1) Enlist the benefits of Cross Sectional Research.
2) Define Research Hypothesis and state its characteristics.
3) Compare between Exploratory and Descriptive Research Design.
4) List the different types of Validity.
5) Mention the characteristics of Primary and Secondary Data.
6) Enlist the major strength and weakness of Probability and Non-probability sampling techniques.
7) Differentiate between Multiple Regression Analysis and Multiple Discriminate Analysis.
8) List the application of statistical software for data analysis.
9) Enlist the need of executive summary in a report.
10) Mention any four features of a Good Research Report.

Part-B **(5×13=65)**

11) a) Summarise the various types of research and discuss their relative advantages and disadvantages.

Or

b) Outline the various types of techniques involved in defining a research problem.

12) a) Elaborate the different types of Research Design with relevant research problems

Or

b) Explain the various types of Scaling and also states their advantages and disadvantages.

13) a) i) Discuss on focus group interview and also states its advantages and disadvantages. (07)
a) ii) Explain in detail about the construction of Questionnaire. (06)

Or

13) b) Discuss the importance of Sampling Design and also explain the methods of determining Sample Size.

14) a) Discuss the various types of analysis of data and state the assumptions made and significance of it.

Or

b) Outline the basic principles and purpose of Factor Analysis and explain how to interpret the results of factor analysis.

15) a) Elaborately discuss the types of Research Report and also outline the precautions to be considered for waiting a Research Report.

Or

b) i) Explain the application of graphic technique in the preparation of a Research Report. (06)
ii) Discuss in detail about the ethical issues involved in research. (07)

Part-C **(1×15=15)**

16) a) Suggest suitable methods for data collection by big business houses in recent times.

Or

b) A company manufacturing brand new personal cars would like to identify potential market segment for their brand. Suggest suitable research design to identify market potential.

ANNA UNIVERSITY, CHENNAI

MBA - SECOND SEMESTER EXAMINATION, APRIL/MAY-2019

BUSINESS RESEARCH METHODS

Time: 3 Hours **Max. Marks: 100**

Note: Answer All Questions.

Part-A **(10×2=20)**

1) Differentiate concept and construct.
2) What is a Null hypothesis?
3) Differentiate control and experimental group.
4) Differentiate internal and external validity.
5) What is double sampling?
6) What is probing in an interview?
7) How to handle don't know responses' in tabulation?
8) What is a dummy variable?
9) What is 'pace' in the context of research report?
10) What are perfactory items?

Part-B **(5×13=65)**

11) a) Explain research process with a neat diagram.

Or

b) i) Explain the different types of variables. (09)
ii) State a research title of your choice and identify the different types of variables in the stated title. (04)

12) a) Explain the different response scales used in questionnaire development with examples for each.

Or

b) Discuss the various threats faced by the researcher in ensuring validity of an experimental research design.

13) a) An analyst sought to predict the annual sales for a home furnishing manufacturer using the following predictor variables:
X1 = Marriages during the year; X2 = Housing starts during the year
X3 = Annual disposable personal income

Using data for 24 years, the analyst calculated the following estimating equation.
$Y = 49.85 - 0.068\ X1 + 0.036\ X2 + 1.22\ X3$

The analyst also calculated an $R^2 = 0.92$ and a standard error of estimate of 11.9.

Interpret the above equation and statistics.

Or

b) How are factor loadings, Eigen value, scree plot, cumulative % of variance explained interpreted in factor analysis? You can make necessary assumptions.

14) a) Compare the advantages and disadvantages of the survey to those of interviews. Under which circumstances could you use interviews to collect data?

Or

b) Give a detailed account on behavioural and non-behavioural observation techniques.

15) a) Discuss the structure of the report in detail.

Or

b) Research reports often contain statistical materials of great importance that are presented poorly. Discuss ways to improve statistical presentations.

Part-C **(1×15=15)**

16) a) Give a brief account of a research you want to do in the near future and design a consent form for that research.

Or

b) Explain the meaning, source identification and purpose of research questions problems and objectives in the field of business management research.

UNIT-WISE CLASSIFICATION OF PREVIOUS YEAR QUESTION PAPERS

UNIT - I

Second Semester Examination, 2014

1) What is meant by business research?

11 a) Write in detail about the factors affecting business research.

11 b) Discuss the role of theory in research.

Second Semester Examination, 2015

1) Differentiate descriptive research from analytical research.

2) What is the role of theory in research?

11 a) Briefly explain the techniques involved in defining a research problem with an example.

Second Semester Examination, 2016

1) What is empirical research?

2) Define "Hypothesis".

3) What is a "Variable" in research?

11 a) Explain the meaning, source identification purpose of research questions, problems and objectives in the field of business management research.

11 b) Mention and discuss various types of research with suitable examples from the business management point of view.

Second Semester Examination, 2017

1) How would you describe the research process?

2) What is the purpose of a literature survey?

11 a) Is there an advantage in stating the hypothesis both in the null and in the alternate? Justify your answer with an example.

11 b) "Research is much concerned with proper fact finding, analysis and evaluation". Do you agree with this statement? Give reasons in support of your answer.

Second Semester Examination, 2018

1) Enlist the benefits of Cross Sectional Research.

2) Define Research Hypothesis and state its c haracteristics.

11 a) Summarise the various types of research and discuss their relative advantages and disadvantages.

11 b) Outline the various types of techniques involved in defining a research problem.

Second Semester Examination, 2019

1) Differentiate concept and construct.

2) What is a Null hypothesis?

11 a) Explain research process with a neat diagram.

16 a) Give a brief account of a research you want to do in the near future and design a consent form for that research.

16 b) Explain the meaning, source identification and purpose of research questions problems and objectives in the field of business management research.

UNIT - II

Second Semester Examination, 2014

3) Explain briefly about research design.

4) Write about experimental group and control group.

Second Semester Examination, 2015

4) What is a rating scale?

12 a) Briefly explain the types of experimental designs used in business.

12 b) Discuss the various types of measurement scales.

Second Semester Examination, 2016

4) Give meaning for the term "Reliability".

12 a) Illustrate the research design process, types and benefits in the context of any functional management research.

12 b) Explain the step by step course of action of construction a research scale and give an outline of a scale on a title of your choice.

Second Semester Examination, 2017

3) List the significance of research design.

4) List any two demerits of experimental and control groups?

9) What is research proposal?

12 a) Whenever possible, it is advisable to use instruments that have already been developed and repeatedly used in published studies, rather than develop our own instruments for our studies. Do you agree? Discuss the reasons for your answer.

12 b) Explain the concept of "trade-off between internal validity and external validity".

Second Semester Examination, 2018

3) Compare between Exploratory and Descriptive Research Design.

4) List the different types of Validity.

12 a) Elaborate the different types of Research Design with relevant research problems.

12 b) Explain the various types of Scaling and also states their advantages and disadvantages.

16 b) A company manufacturing brand new personal cars would like to identify potential market segment for their brand. Suggest suitable research design to identify market potential.

Second Semester Examination, 2019

3) Differentiate control and experimental group.
4) Differentiate internal and external validity.
11 b) i) Explain the different types of variables.
11 b) ii) State a research title of your choice and identify the different types of variables in the stated title.
12 a) Explain the different response scales used in questionnaire development with examples for each.
12 b) Discuss the various threats faced by the researcher in ensuring validity of an experimental research design.

UNIT – III

Second Semester Examination, 2014

2) Define data, information and intelligence.
5) List out the characteristics of a good sample design.
6) Distinguish between primary data and secondary data.
12 a) What is focus group interview? Write about the advantages of focus group interviews.
12 b) Explain in detail about in-depth interviews.
13 a) Discuss the role of direct observation as a business research method.
13 b) Discuss the importance of sampling design.

Second Semester Examination, 2015

3) What is content validity?
5) What is quota sampling?
6) What are the advantages of survey method?
13 a) Discuss the methods of data collection by big business houses in recent times.
13 b) Describe the methods of determining sample size.

Second Semester Examination, 2016

5) What do you mean by secondary data?
6) What is "Sampling Plan"?
13 a) List out the different methods of primary data collection to carry out a business research and explain the purpose of every method.
13 b) Differentiate probability method of sampling from that of non-probability method of sampling providing examples for each.

Second Semester Examination, 2017

5) Enumerate the different methods of collection of data.
6) State any two problems faced in collection of data through schedules?
13 a) "Every data collection method has its own built-in biases. Therefore, resorting to in multi-methods of data collection is only going to compound the biases". How would you critique this statement?
13 b) Explain the principles of wording, stating how these are important in questionnaire design, citing a few examples.

Second Semester Examination, 2018

5) Mention the characteristics of Primary and Secondary Data.
6) Enlist the major strength and weakness of Probability and Non-probability sampling techniques.
13 a) i)Discuss on focus group interview and also states its advantages and disadvantages.
13 a) ii) Explain in detail about the construction of Questionnaire.
13 b) Discuss the importance of Sampling Design and also explain the methods of determining Sample Size.
16 a) Suggest suitable methods for data collection by big business houses in recent times.

Second Semester Examination, 2019

5) What is double sampling?
6) What is probing in an interview?
14 a) Compare the advantages and disadvantages of the survey to those of interviews. Under which circumstances could you use interviews to collect data?
14 b) Give a detailed account on behavioural and non-behavioural observation techniques.

UNIT – IV

Second Semester Examination, 2014

7) Differentiate between multiple regression analysis and multiple discriminant analysis.
8) What is the difference between Type I and Type II error?
14 a) Write short notes on:
   i) Cross tabulation
   ii) Multi-collinearity
   iii) Coefficient of variation
   iv) Analysis of variance (ANOVA)
14 b) What is multivariate data analysis? Classify and explain about multivariate techniques.

Second Semester Examination, 2015

7) What is discriminant analysis?
8) What is MDS?
11 b) Write down a procedure for hypothesis testing.
14 a) Describe the Bivariate data analysis procedures.
14 b) Explain the steps in cluster analysis.

Second Semester Examination, 2016

7) What do you understand by "Data Coding"?
8) Define "Bivariate Analysis".
14 a) Discuss about measures of central tendency and how they are useful in any business research work?
14 b) Explain the objective, process and application of multiple regression and correlation analysis to solve business research problems.

Second Semester Examination, 2017

7) What do you mean by one-tailed test and two-tailed test?

8) Explain briefly about acceptance region and rejection region.

14 a) "The procedure of testing hypothesis requires a researcher to adopt several steps." Describe in brief all such steps.

14 b) What is the significance of using multiple discriminant analysis? Explain the technical details involved in such a technique.

Second Semester Examination, 2018

7) Differentiate between Multiple Regression Analysis and Multiple Discriminate Analysis.

8) List the application of statistical software for data analysis.

14 a) Discuss the various types of analysis of data and state the assumptions made and significance of it.

14 b) Outline the basic principles and purpose of Factor Analysis and explain how to interpret the results of factor analysis.

Second Semester Examination, 2019

7) How to handle don't know responses' in tabulation?

8) What is a dummy variable?

13 a) An analyst sought to predict the annual sales for a home furnishing manufacturer using the following predictor variables:

X1 = Marriages during the year; X2 = Housing starts during the year

X3 = Annual disposable personal income

Using data for 24 years, the analyst calculated the following estimating equation.

$Y = 49.85 - 0.068\ X1 + 0.036\ X2 + 1.22\ X3$

The analyst also calculated an $R^2 = 0.92$ and a standard error of estimate of 11.9.

Interpret the above equation and statistics.

13 b) How are factor loadings, Eigen value, scree plot, cumulative % of variance explained interpreted in factor analysis? You can make necessary assumptions.

UNIT – V

Second Semester Examination, 2014

9) What is meant by ethical dilemma?

10) How do you define Interpretation?

15 a) Explain elaborately about research report and its format.

15 b) What precautions should be taken while preparing research report?

Second Semester Examination, 2015

9) What are the contents of executive summary?

10) What is referencing?

15 a) Suggest an outline of the research report that is generally accepted as the basic format for most research projects.

15 b) State the precautions in writing a research report.

Second Semester Examination, 2016

9) State the difference between subjectivity and objectivity.

10) What are the different types of research reports?

15 a) Describe the process of report preparation. Discuss the importance of objectivity in writing a Marketing/ Finance/ Human Resource research report.

15 b) Discuss the importance of language, cauterisation, tone, and proof reading in a research report preparation.

Second Semester Examination, 2017

10) What should be the part of executive summary?

15 a) How have technological advancements helped in writing and presenting research reports? Why is it necessary to specify the limitations of the study in the research report?

15 b) Write short notes on the following:

i) Characteristics of a good research report.

ii) Bibliography and its importance in context of research report.

Second Semester Examination, 2018

9) Enlist the need of executive summary in a report.

10) Mention any four features of a Good Research Report.

15 a) Elaborately discuss the types of Research Report and also outline the precautions to be considered for waiting a Research Report.

15 b) i) Explain the application of graphic technique in the preparation of a Research Report.

15 b) ii) Discuss in detail about the ethical issues involved in research.

Second Semester Examination, 2019

9) What is 'pace' in the context of research report?

10) What are perfactory items?

15 a) Discuss the structure of the report in detail.

15 b) Research reports often contain statistical materials of great importance that are presented poorly. Discuss ways to improve statistical presentations.

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